

**Vegetation Monitoring Report for
"Golf Course" Interim Remedial
Action, Smelter/Tailing Soils
Investigation Unit**

Freeport-McMoRan Chino Mines Company

Vanadium, New Mexico

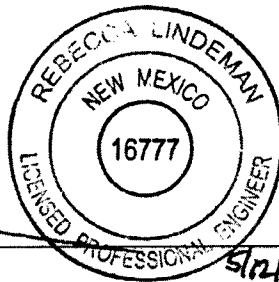
May 2014



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Rebecca Lindeman, P.E.
Principal Civil Engineer



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for "Golf Course" – Interim
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Investigative Unit**

Freeport-McMoRan Chino Mines
Company
Vanadium, New Mexico

Prepared for
Freeport-McMoRan Chino Mines
Company

Prepared by:
ARCADIS
1687 Cole Blvd.
Suite 200
Lakewood
Colorado 80401
Tel 303.231.9115
Fax 303.231.9571

Our Ref.:
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Soil Investigation Unit**

Chino Mines Company,
Vanadium, New Mexico

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1. Introduction

This final vegetation monitoring report (report) for the Smelter and Tailings Soil Investigation Units (STSIU) Interim Removal Action (IRA) has been prepared on behalf of the Freeport-McMoRan Chino Mines Company (Chino) in accordance with the Administrative Order on Consent (AOC) between Chino and the New Mexico Environment Department (NMED). The *Smelter/Tailing Soils Investigation Unit Interim Removal Action Completion Report* (hereafter Completion Report, ARCADIS 2009) documented completion of all associated IRA activities, which occurred on the former golf course site immediately north and west of the Town of Hurley. The IRA project site will hereafter be referred to as the Golf Course site. A site location map is included as Figure 1. Work was undertaken to address elevated copper in surface soil and was completed in August 2008. Removal of surface soils was completed as documented in the Completion Report (ARCADIS 2009).

1.1 Project Background

Multiple investigation units (IUs) associated with historical mineral processing operations at the site were designated in the AOC. These included the Lampbright IU, Hanover Creek Channel IU, Whitewater Creek Channel IU, Smelter Soils IU, Hurley Soil IU, and the Tailings Soils IU. The Smelter and Tailings Soils IUs have been combined to form the STSIU. The Golf Course IRA specifically addressed surface soil impacts in the STSIU. The STSIU includes the former copper smelter, ancillary facilities, and the tailings disposal facilities. Tailing areas are defined by the AOC as all soils adjacent to the Chino tailings ponds and those soils shown to be potentially affected by the tailing.

Copper was identified as the driver constituent for this IRA. Based on the *Advisory Group Formal Dispute Resolution for the Chino AOC Hurley Soils IU* (HSIU), an amendment to the AOC dated July 28, 2005 set a pre-feasibility study (FS) remedial action criterion for the HSIU of 5,000 milligrams per kilogram (mg/kg) for copper in soil to be protective of human health in a residential exposure scenario (Chino 2005). Due to the potential future use of the Golf Course site as residential as an expansion of the Town of Hurley, this IRA was a continuation of the HSIU IRA, and thus, the 5,000 mg/kg residential criterion was used for horizontal delineation. The current and likely future uses of the property are grazing and wildlife habitat.

The area identified for removal in the *Interim Removal Action Work Plan, Smelter Soil Investigation Units* (hereafter Work Plan, ARCADIS BBL, Inc. 2007) was approximately 190 acres based on surface soil copper concentrations greater than 5,000 mg/kg. The planned excavation depth for the Golf Course site was defined as a minimum of 2 inches below ground surface (bgs). In the majority of areas, impacts occurred only in

the near surface soil (0 to 2 inches bgs). In 2008, heavy equipment was used to scrape the first 2 to 3 inches of soil for removal. Following soil removal, the exposed soil was sampled to confirm that the remedial goal had been achieved. If the goal was not met, then an additional 2 to 3 inches of soil was removed. Once the remediation goal had been achieved, the excavation areas were graded to promote positive drainage (i.e., no sinks or low points). No additional fill was brought to the Golf Course site. These graded areas were then ripped to approximately 2 feet bgs prior to being hydro seeded with a native seed mixture as detailed below and in Table 1.

Excavation depths during the IRA activities averaged 3 inches bgs for the total removal area. Based on confirmation sampling and refinement of the removal areas, approximately 170 acres of the proposed 190 acres were ultimately remediated (Figure 2). The total volume removed during this IRA was estimated at 68,112 cubic yards. Removal of surface soils was documented in Completion Report (ARCADIS 2009).

1.2 Restoration Monitoring

The objective of this report is to document successful revegetation of the Golf Course site after 5 years. Revegetation of the Golf Course site was intended as a means to limit erosion and provide dust control for disturbed areas through re-establishment of a native plant community (ARCADIS 2009). Disturbed areas were revegetated by applying a native seed mix in August 2008, immediately following completion of earth work activities, using a seed mixture presented in the Completion Report (ARCADIS 2009). The seed mixture outlined in the Work Plan (ARCADIS BBL, Inc. 2007) was slightly modified to include more range grasses such as side-oats grama (*Bouteloua curtipendula*, increased from 1.25 to 10 pounds [lbs]/acre). Also (at the recommendation of the seed supplier) to improve success, sand dropseed (*Sporobolus cryptandrus*) was added, bottlebrush squirreltail (*Sitanion hystrix*) was decreased from 1.25 to 0.25 lbs/acre, and thickspike wheatgrass (*Elymus lanceolatus*) replaced New Mexico needlegrass (*Stipa neomexicana*, Table 1).

The Completion Report (ARCADIS 2009) specified that the restored areas would be monitored quarterly to inspect the vegetation cover for dust suppression purposes and to address any significant erosion issues within the areas for 1 year following excavation. For the following 4 years, vegetation inspections were to be conducted annually. The report did not specify if the monitoring was to be qualitative or quantitative. Chino's monitoring efforts exceeded these requirements and included quarterly inspections over 5 years that evaluated the conditions of the vegetation, ditches, stormwater runoff controls, erosion, and fencing. These inspections are documented in Appendix A. For the vegetation inspections over the first 2 years (2009 and 2010), vegetation cover establishment was quantitatively assessed using point counts and photo points on transects. Once determined to be well established with

these data and photographs, the vegetation condition was qualitatively assessed for the following 2 years and then quantitatively assessed in October of the fifth year. All of the inspection and monitoring reports were submitted to NMED, and this report provides the results of the fifth year of quantitative vegetation monitoring.

Results of the quarterly inspections over 5 years and vegetation monitoring in the first 2 years are summarized as follows:

- Years 1 to 5 -- Quarterly Inspections of Ditches, Water Controls, Erosion and Fencing

Quarterly inspections in March, June, September, and December beginning in 2009 and ending in 2013 revealed no major erosion. In September 2009, a small, unseeded area was ripped to decrease ponding. Water ponding was likely the result of soil compaction after construction activities. In December 2011, minor erosion was recorded in the northern portion of the Golf Course site just north of the bridge. No other erosional issues were observed over this 5-year time period. In general, the high clay content of soil and caliche were observed to keep dust controlled. As well, ditches were adequate to control water runoff. Finally, a portion of the fence was observed to be down in December 2010 and subsequently repaired.

- Year 1 – Fall Quantitative Vegetation Monitoring in 2009

Two transects were established in September 2009 (i.e., a year after seeding) to evaluate vegetative cover using the point intercept methodology: Transect 1 in the northern portion of the Golf Course site and east of the rail road tracks; and Transect 2 in the west area and west of the railroad tracks¹. A map of the transect locations and associated data is included in Appendix A. At consistent intervals along each transect, the presence of bare ground, litter, annual vegetation, or perennial vegetation was recorded to estimate percent cover for each of these variables. Along Transect 1, 40 percent of the ground was bare, 12 percent was litter, and 48 percent was vegetation. Of the vegetated cover, 59 percent of the cover was composed of annual species and the rest of perennial species. Similarly, two other locations within the north area qualitatively assessed bare ground cover to be approximately 40 to 55 percent. Along Transect 2, 70 percent

¹ Transect 1 originated at North 32.70895 and East -108.1275458 and Transect 2 originated at North 32.70292 and East -108.13676

of the ground was bare, 2 percent was litter, and 28 percent was vegetated. Of the vegetated cover, 46 percent of the cover was composed of annual species and the rest of perennial species. Similarly, three other locations in the west area qualitatively assessed appeared also to be approximately 70 percent bare ground.

Common grass species found along both transects included side-oats grama, vine mesquite (*Panicum obtusum*), plains bristlegrass (*Setaria leucopila*), purple three-awn (*Aristida purpurea*), blue grama (*Bouteloua gracilis*), fluff grass (*Dasyochloa pulchella*), and sand dropseed. Common herbaceous species included pigweed (*Amaranthus palmeri*), unidentified milkweed (*Asclepias* sp.), broom snakeweed (*Gutierrezia sarothrae*), rattleweed (*Astragalus wootonii*), ragweed (*Amauriopsis dissecta*), Russian thistle (*Salsola tragus*), silverleaf nightshade (*Solanum elaeagnifolium*), hog potato (*Hoffmannseggia glauca*), unidentified globemallow (*Sphaeralcea* sp.), and various composites. Common shrub and tree species included bitterbrush (*Purshia* sp.), soap tree yucca (*Yucca elata*), honey mesquite (*Prosopis glandulosa*), and some Chinese elm (*Ulmus parvifolia*) seedlings. Photographs of these sites in 2009 are provided in Appendix A.

- Year 2 – Fall Quantitative Vegetation Monitoring in 2010

Transects 1 and 2 were again surveyed in September 2010 using the point intercept methodology. Transect 1 had 66 percent vegetative cover with only 30 percent bare ground and 4 percent litter. Similarly, one other location in the north area was qualitatively estimated to have approximately 35 to 40 percent bare ground. Transect 2 was qualitatively surveyed with an estimate of about 50 percent bare ground. One additional location in the west area demonstrated similar conditions with an assessment of approximately 40 percent bare ground.

Common species observed along both transects included side-oats grama, vine mesquite, silverleaf nightshade, Russian thistle, broom snakeweed, ragweed, unidentified globemallow, and winterfat (*Krascheninnikovia lanata*). Other species observed outside the transects included soap tree yucca and pigweed.

These data demonstrate that vegetative cover recovered in just 2 years to percent cover values similar to an un-impacted reference area (e.g., 54 percent, see reference area data in Table 8 of Daniel B. Stephens & Associates 1999). Representative site photographs are included in Appendix A, and show that vegetation was well established by fall 2010. Annual quantitative vegetation monitoring was ceased after September 2010 survey due to the documented success of vegetation establishment, and sufficient information provided by

quarterly inspections. Quantitative vegetation monitoring was resumed in fall of 2013 to document conditions at the end of the monitoring period.

This final report describes conditions within the Golf Course site 5 years after the completion of remediation activities. The monitoring results described herein are intended to evaluate the degree of success towards achieving success guidelines for this project, which are to control dust and erosion and re-establish the vegetation community (ARCADIS 2009). For the purposes of this report, vegetation success guidelines detailed in the *Interim Technical Standards for Revegetation Success – Chino Mines Company* (Daniel B. Stephens & Associates, Inc. 1999) and *Chino Closure/Closeout Plan Update* (CCP Plan, Chino 2007) helped guide the evaluation project success, but were not the only criteria evaluated. Because erosion control was the principal performance objective for this revegetation project, canopy cover was the most important factor evaluated.

2. Success Criteria

Revegetation of the Golf Course site was intended as a means to limit erosion and provide dust control for disturbed areas through re-establishment of a native plant community (ARCADIS 2009). In doing so, vegetation will enhance wildlife use and rangeland conditions. For the purposes of this report, success guidelines detailed in the *Interim Technical Standards for Revegetation Success – Chino Mines Company* (Daniel B. Stephens & Associates, Inc. 1999) and CCP Plan (Chino 2007) were used to help guide evaluation of project success in terms of successful establishment of plant cover. Successful establishment of plant cover will help limit erosion and control dust. The success criteria for vegetation cover was developed for the purpose of reclaiming tailings areas and, for cover, are based upon analysis of vegetation data collected in the Closure/Closeout Plan (CCP) Tailing Reference Area just west of Tailing Pond 7, referred as the South Mine Reference Site.

Based on the 1999 reference area analysis (Daniel B. Stephens & Associates, Inc. 1999), canopy cover success criterion was set at approximately 38 percent. This percentage from CCP success criterion is 70 percent of the vegetation cover on the Tailings Reference Area, and is based on the assumption that 12 years after reclamation (typical bond release period), a reclamation site should be at 70 percent of the percent cover of reference areas that are at full maturation. The Golf Course is not a reclamation site nor expected to be a community at full maturation after 5 years. Nevertheless, the 38 percent cover criterion was used to assess if vegetation establishment had occurred over the monitoring period close to an expected level of canopy coverage after 12 years of succession. Such a level of canopy coverage is expected to prevent or limit soil erosion.

In addition to comparison to cover, the revegetation would be considered successful if a plant community without noxious species was established composed of a number of different life-classes (grasses, forbs, and shrubs). Evidence of colonization of native (not-seeded) species would also demonstrate that the Golf Course site is undergoing natural re-colonization as part of succession to a native plant community, which should provide long-term erosion and dust control on the site while also providing wildlife habitat and rangeland potential as secondary benefits.

3. Monitoring Methods

Methods to evaluate the success of revegetation efforts were similar with those used on the CCP South Mine Reference Site reported in Daniel B. Stephens & Associates, Inc. (1999). Using the same methods allows comparison to the historical data collected at the South Mine Reference Site; data which was intended to provide a local representation of the ecological potential of the reclaimed plant communities in the mixed grama herbaceous alliance (Newfields 2005). The Golf Course site occurs in the mixed grama herbaceous alliance (west of railroad tracks) and mesquite/mixed grama alliance (east of railroad tracks).

On October 9, 2013, a transect/quadrat system was established for use as the framework to collect percent cover and density data. The Golf Course site was divided into a grid of 100-foot by 100-foot blocks as illustrated on Figure 2. Random-grid coordinates were used to select three blocks in areas east of the railroad tracks and two blocks west of the railroad tracks. Coordinates for the southwestern corner of each selected block are included in Table 2. Two 50-foot transects originated in the southwestern corner, with bearings to the north and east. A 3.3-foot by 3.3-foot quadrat (or 1-meter square) was placed at the 15- and 30-foot locations along each 50-foot transect (vegetation plot shown on Figure 3).

In each quadrat, a professional botanist visually estimated total canopy cover, individual species canopy cover, total basal cover, and individual species basal cover near the end of the growing season in October 2013. For this study, canopy cover is defined as the percentage of the quadrat area included in the vertical projection of the canopy (Daubenmire 1968). Canopy cover estimates included the foliage and foliage interspaces of all individual plants rooted in the quadrat. When evaluating percent canopy cover for each identified species within a quadrat, the sum of the estimates could exceed 100 percent within an individual quadrat because of foliage overlaps. The sum of total canopy cover, surface litter, rock fragments, and bare soil could not exceed 100 percent. Basal cover is defined as the proportion of ground occupied by vegetation on the ground surface, specifically the crowns (where shoots and roots meet) of grasses and stems of forbs and shrubs where the stems meet the roots. Like the total canopy cover estimates, the total basal cover estimates could not exceed 100 percent. Basal cover for vegetation is always less than canopy cover because canopy cover includes all vegetation cover. Percent of area within the quadrat in surface litter, surface rock fragments, and bare soil was estimated at the ground level (basal estimates) and by looking down from the canopy level.

Species occurrence was determined by traversing the entire block area and listing all the vegetation species encountered. Shrub density, or the number of plants per square meter quadrat, was determined by counting all individuals within each quadrat and

averaging over all quadrats within a given block. In addition, the point-centered quarter (PCQ) method (Bonham 1989) was used at each quadrat location to estimate woody plant density. The terminal nodes of each transect were used as the fixed points for the PCQ distance measurements (Figure 3). Shrub density data were averaged across quadrats for each block and then averaged across all blocks to obtain average estimates for the Golf Course site.

4. Results

The following section summarizes results of comprehensive vegetation sampling completed on October 9, 2013, following the methods detailed in Section 3. Data are summarized in Tables 3, 4, and 5 and on Figures 4 and 5. Raw data by vegetation plot within each block are included in Appendix B. Photographs of the vegetation and sampling are provided in Appendix C.

4.1 Total Canopy Cover

Total vegetative canopy cover in 2013 averaged 62 percent across the Golf Course site (Table 5). This exceeds the criterion of total canopy cover of 38 percent. Evaluating total canopy cover of the two respective areas east and west of the railroad tracks, average canopy cover was 47 percent in the north area east of the railroad tracks and 79 percent in the west area (west of the tracks). While areas west of the tracks exhibited higher percent canopy cover (opposite of trend 2 years after seeding), both areas exceeded the success criterion.

Estimates of average total canopy cover of rock fragments, bare soil, and surface litter across the 20 quadrats were 19, 14, and 5 percent, respectively (Table 5 and Figure 4). Average basal cover estimates for vegetation, rock fragments, bare soil, and surface litter were 34, 32, 25, and 10 percent, respectively (Table 5 and Figure 5).

Estimates of proportional vegetative canopy cover across the 20 quadrats in order of dominance by life form were 36 percent perennial grasses, 33 percent perennial forbs, 27 percent annual forbs, 3 percent shrubs, 1 percent annual grasses, and 1 percent tree seedlings (Figure 4). Proportional basal cover by life form were 53 percent perennial grasses, 21 percent annual forbs, 19 percent perennial forbs, 5 percent shrubs, 2 percent annual grasses, and 1 percent tree seedlings (Figure 5). As expected with vegetative succession, annual species have declined since Year 1 when an average of 53 percent of vegetative cover was annuals compared to 29 percent in Year 5.

4.2 Vegetation Diversity

A total of 25 vegetation species were identified within the 20 quadrats. Based upon the species surveys of the five randomly selected blocks, a total of 39 vegetation species were identified. Table 3 provides a comprehensive list of plant species identified during October 2013 surveys.

The following vegetative community composition was documented in 2013:

- Seven warm season grasses were identified across the five blocks. Percent canopy cover for the five species identified in quadrats are: side-oats grama (25 percent), blue grama (*B. gracilis*, 4 percent), purple three awn (23 percent), tobosa (*Pleuraphis mutica*, 5 percent), and beardgrass (*Bothriochloa barbinoides*, 3 percent) (Table 4). Windmill grass (*Chloris verticillata*) and witchgrass (*Panicum capillare*) are other grasses identified outside the quadrats. Many of these species were dominant species identified at the South Mine Reference Site.
- Seven perennial warm season and two annual warm season grass species were identified during the survey, including seven native volunteers (which were not seeded) (i.e., five perennial warm season, and two annual warm season grasses). The original seed mix included five warm season grasses, one intermediate season grass, and three cool season grasses (Table 1). From the original seed mix, three warm season grasses (side-oats grama, blue grama, and sand dropseed) established in the first year, and two remained (side-oats grama, blue grama) in the fifth year. The colonization by seven additional native grass species indicates that the Golf Course site provides good potential for further diversification, contributing to wildlife habitat and rangeland condition.
- Three shrub species were identified across the five randomly selected blocks. Percent canopy cover for the three species based upon quadrat data are: soap tree yucca (10 percent), winterfat (5 percent), and honey mesquite (3 percent) (Table 4). Winterfat was the one shrub of three in the seed mix that established. It was also the dominant shrub species at the South Mine Reference Site, with a comparable canopy cover (5 percent). The relative cover and proportion of shrub species in these community alliances are expected to increase with time as the plant community matures.
- Four annual forbs and 10 perennial forbs were identified across the five randomly selected blocks. Commonly identified native forbs, along with their average canopy cover (based upon quadrat data), included: bearded dalea (*Dalea pogonathera*, 15 percent), scaly globemallow (*Sphaeralcea leptophylla*, 8 percent), spreading fan petals (*Sida abutilifolia*, 4 percent), and blackfoot (*Melampodium leucanthum*, 3 percent) (Table 4). Globemallow was the one forb of three in the seed mix that established (assuming the species in the seed mix was scaly globemallow). Russian thistle was the only non-native present, and was not present in high enough abundance to be found on the quadrats. No noxious weeds were present on the Golf Course site.

4.3 Shrub Density

As noted above, a total of three shrub species were identified. It is important to note that the dominant shrub identified within the quadrats (i.e., winterfat) was consistent with conditions documented at the CCP South Mine Reference Site. In addition, the occurrence of soap tree yucca and honey mesquite demonstrates that native species are naturally colonizing the Golf Course site. Observed site conditions are good and indicative of an early-seral stage mixed grama community, as described in the *Comprehensive Vegetation Survey of Chino Mine* (Daniel B. Stephens & Associates, Inc. 2000). It is anticipated that shrub species will continue to colonize the Golf Course site over time, and that establishment of shrubs requires a longer time interval when compared to herbaceous species.

4.4 Precipitation

The amount and distribution of precipitation affect the rate of vegetation establishment. Once established, the precipitation dynamics affect the vegetation cover levels on a year-to-year basis, with grasses and forbs showing the most immediate affects. Precipitation records for the past 6 years (2008 through 2013) are shown in Table 6, collected at a gauge near Pond 7 on the Chino site south of the Golf Course. The average precipitation at this gauge for the 6-year period was 11 inches. This compares to the annual average precipitation regionally at the Ft. Bayard gauge of approximately 16 inches. The precipitation data in Table 6 show that precipitation levels for all 5 years since seeding of the Golf Course site (2009 through 2013) fall below this average. In particular, 2011 was dry during the growing season, and record drought conditions occurred in 2012 with a specific lack of late season precipitation.

The success of established seeded plant species, in addition to documented natural recruitment by a diversity of native species despite the drought conditions, is a testament to the site potential for further diversification, contributing to wildlife habitat and rangeland condition.

5. Summary

This report describes conditions observed on October 9, 2013 across the Golf Course site, 5 years after completion of the IRA. Revegetation of the site was intended as a means to limit erosion and provide dust control for disturbed areas. In doing so, the project intended to establish a diverse plant community capable of controlling erosion. For the purposes of this report, a success guideline for canopy cover of 38 percent was used as a basis to evaluate project success in terms of vegetation establishment. While the canopy cover standard is applied to communities that have established 12 years after reclamation rather than 5 years, it provides a quantitative means for evaluating the progress of development of plant communities. Plant communities were also evaluated in terms of colonization by native species to determine if a diverse community has established that is capable of controlling erosion.

The 2013 results demonstrate the successful development of an early-seral stage mixed grama herbaceous alliance across the Golf Course site. The canopy cover levels exceed the reference area guidance for canopy cover, and the data indicate that native species have and are continuing to colonize the site with minimal cover from non-native species. Therefore, given the early successional status of the 5-year old community, vegetation establishment has been successful and will continue to limit erosion and control dust. These results are particularly encouraging in recognition of the severe drought conditions that have plagued New Mexico in 4 of the last 5 years.

No significant erosional or dust issues were documented during this 5-year monitoring period, and the currently established plant community appears to have met the overall objective as a best management practice. This community provides significant cover across the Golf Course site, while also providing both ecological and rangeland value to this reclaimed land. In conclusion, revegetation efforts across the Golf Course site have been successful per the approved success criteria, and no additional monitoring is necessary.

6. References

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Table 1
Golf Course Seed Mix and Application Rates

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Smelter Tailings Soils IU

Species	Life-Form	Duration	Seasonality	Rate (lbs/acre)
Blue grama (<i>Bouteloua gracilis</i>)	Grass	Per	Warm	0.25
Side-oats grama (<i>Bouteloua curtipendula</i>)	Grass	Per	Warm	10.00
Black grama (<i>Bouteloua eriopoda</i>)	Grass	Per	Warm	0.10
Green sprangletop (<i>Leptochloa dubia</i>)	Grass	Per	Warm	0.15
Sand dropseed (<i>Sporobolus cryptandrus</i>)	Grass	Per	Warm	0.10
Plains lovegrass (<i>Eragrostis intermedia</i>)	Grass	Per	Intermediate	0.05
Bottlebrush squirreltail (<i>Sitanion hystrix</i>)	Grass	Per	Cool	0.25
Thickspike wheatgrass (<i>Elymus lanceolatus</i>)	Grass	Per	Cool	1.75
Streambank wheatgrass (<i>Agropyron distachyum</i> v. <i>riparium</i>)	Grass	Per	Cool	1.50
Apache plume (<i>Fallugia paradoxa</i>)	Shrub	Per	NA	0.10
Rubber rabbitbush (<i>Chrysothamnus nauseosus</i>)	Shrub	Per	NA	0.05
Winterfat (<i>Krascheninnkovia lanata</i>)	Shrub	Per	NA	0.60
Yellow sweet clover (<i>Melilotus officinalis</i>)	Forb	Ann	NA	0.15
Globemallow (<i>Sphaeralcea</i> sp.)	Forb	Per	NA	0.10
Blue flax (<i>Linum lewisii</i>)	Forb	Per	NA	0.15
Total PLS (lb/ac)				7.45

Total PLS (lbs/acre) 15.30

Notes:

Ann = Annual
Per = Perennial

NA = Not Applicable
PLS = Pure Live Seed

Table 2
Locations of Blocks Selected for Cover and Density Analysis

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Smelter Tailings Soils IU

Block	Northing	Easting
1	32.70967	-108.13042
2	32.70857	-108.12879
3	32.70775	-108.12651
6	32.70718	-108.13463
7	32.70391	-108.13404

Note:

Coordinates are provided for the southwestern corner of each selected block.

Table 3
Species List - Vegetation Identified by Plant Survey in October 2013

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Smelter Tailings IU

Species Name		Stratum	Seasonality
Common	Latin		
Acacia seedling	<i>Acacia sp.</i>	Annual forb	
Wild onion	<i>Allium macropetalum</i>	Perennial forb	
Carelessweed or pigweed	<i>Amaranthus palmeri</i>	Annual forb	
Bahai, yellow ragweed	<i>Amauriopsis dissecta</i>	Perennial forb	
Arizona three awn	<i>Aristida arizonica</i>	Perennial grass	Warm
Purple three awn	<i>Aristida purpurea</i>	Perennial grass	Warm
Beardgrass	<i>Bothriochloa barbinodis</i>	Perennial grass	Warm
Six-weeks grama	<i>Bouteloua barbata</i>	Annual grass	Warm
Side-oats grama	<i>Bouteloua curtifendula</i>	Perennial grass	Warm
Blue grama	<i>Bouteloua gracilis</i>	Perennial grass	Warm
Baby aster	<i>Chaetopappa ericoides</i>	Perennial forb	
Lambsquarters	<i>Chenopodium album</i>	Annual forb	
Windmill grass	<i>Chloris verticillata</i>	Perennial grass	Warm
Dagger bindweed	<i>Convolvulus equitans</i>	Perennial forb	
Unknown cucumber	Cucurbitaceae unknown		
Bearded dalea	<i>Dalea pogonathera</i>	Perennial forb	
Dogweed	<i>Dyssodia papposa</i>	Annual forb	
Broom snakeweed	<i>Gutierrezia sarothrae</i>	Perennial forb	
Annual sunflower	<i>Helianthus annuus</i>	Annual forb	
Winterfat	<i>Krascheninnikovia lanata</i>	Shrub	
Tansy aster	<i>Machaeranthera tanacetifolia</i>	Annual forb	
Blackfoot	<i>Melampodium leucanthum</i>	Perennial forb	
Wait-a-minute	<i>Mimosa biuncifera</i>	Shrub	
Spreading four-o'clock	<i>Mirabilis oxybaphoides</i>	Perennial forb	
Purple loco	<i>Oxytropis lambertii</i>	Perennial forb	
Witchgrass	<i>Panicum capillare</i>	Annual grass	Warm
Tobosa	<i>Pleuraphis mutica</i>	Perennial grass	Warm
Unknown grass	Poaceae unknown		
Honey mesquite	<i>Prosopis glandulosa</i>	Shrub	
Russian thistle	<i>Salsola tragus</i>	Annual forb	
Twin leaf senna	<i>Senna bauhinioides</i>	Perennial forb	
Spreading fan petals	<i>Sida abutifolia</i>	Perennial forb	
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	Perennial forb	
Scarlet globemallow	<i>Sphaeralcea coccinea</i>	Perennial forb	
Scaly globemallow	<i>Sphaeralcea leptophylla</i>	Perennial forb	
Chinese elm	<i>Ulmus parvifolia</i>	Tree (seedling)	
Golden crownbeard	<i>Verbesina encelioides</i>	Annual forb	
Soap tree yucca	<i>Yucca elata</i>	Shrub	
Wild zinnia	<i>Zinnia grandiflora</i>	Perennial forb	
Unknown seedling			

Table 4
Species Cover Data Statistics

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Smelter Tailings Soils IU

Species Name		Stratum	Frequency (n=20)	Mean Cover (%)	
Common	Latin			Basal	Canopy
Carelessweed or pigweed	<i>Amaranthus palmeri</i>	Annual forb	16	5.8	15.8
Acacia seedling	<i>Acacia sp.</i>	Annual forb	7	1.5	6.6
Dogweed	<i>Dyssodia papposa</i>	Annual forb	3	0.1	3.4
Tansy aster	<i>Machaeranthera tanacetifolia</i>	Annual forb	2	0.1	1.6
Six-weeks grama	<i>Bouteloua barbata</i>	Annual grass	2	5.1	7.5
Bearded dalea	<i>Dalea pogonathera</i>	Perennial forb	20	3.9	14.9
Dagger bindweed	<i>Convolvulus equitans</i>	Perennial forb	4	0.1	7.5
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	Perennial forb	5	1.2	5.2
Scaly globemallow	<i>Sphaeralcea leptophylla</i>	Perennial forb	2	1.6	7.5
Spreading fan petals	<i>Sida abutilifolia</i>	Perennial forb	11	1.5	4.3
Blackfoot	<i>Melampodium leucanthum</i>	Perennial forb	12	0.7	2.5
Scarlet globemallow	<i>Sphaeralcea coccinea</i>	Perennial forb	1	0.1	2.0
Baby aster	<i>Chaetopappa ericoides</i>	Perennial forb	4	0.1	1.6
Twin leaf senna	<i>Senna bauhinoides</i>	Perennial forb	1	0.1	0.1
Side-oats grama	<i>Bouteloua curtipendula</i>	Perennial grass	18	18.9	24.9
Purple three awn	<i>Aristida purpurea</i>	Perennial grass	2	7.5	22.5
Tobosa	<i>Pleuraphis mutica</i>	Perennial grass	1	5.0	5.0
Blue grama	<i>Bouteloua gracilis</i>	Perennial grass	8	3.6	3.9
Beardgrass	<i>Bothriochloa barbinodis</i>	Perennial grass	1	3.0	3.0
Soap tree yucca	<i>Yucca elata</i>	Shrub	4	8.8	10.0
Winterfat	<i>Krascheninnikovia lanata</i>	Shrub	1	5.0	5.0
Honey mesquite	<i>Prosopis glandulosa</i>	Shrub	1	0.1	3.0
Chinese elm	<i>Ulmus parvifolia</i>	Tree (seedling)	1	3.0	3.0
Unknown grass			1	0.1	3.0
Unknown seedling			5	0.7	1.3

Note:

Data were collected from across the 20 established survey quadrats in 2013.

Table 5
Summary Statistics

Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Smelter Tailings Soils IU

Component	Mean	S.D.	90% CL	n
<i>Total Cover</i>				
Canopy (%)	62.0	20.3	7.5	20
Rock (%)	18.5	12.6	4.6	20
Bare Soil (%)	14.3	10.0	3.7	20
Litter (%)	5.3	1.1	0.4	20
<i>Basal Cover</i>				
Vegetation (%)	33.5	15.4	5.7	20
Rock (%)	31.8	18.9	6.9	20
Bare Soil (%)	24.8	9.5	3.5	20
Litter (%)	10.0	4.6	1.7	20
<i>Shrub Density</i>				
PCQ (shrubs/m ²)	0.045	0.040	0.023	8

Notes:

Data were collected from across the 20 established survey quadrats in 2013.

% - percent

m² - square meter

PCQ = point center quarter method of sampling

S.D. = Standard deviation

CL = Confidence Limits

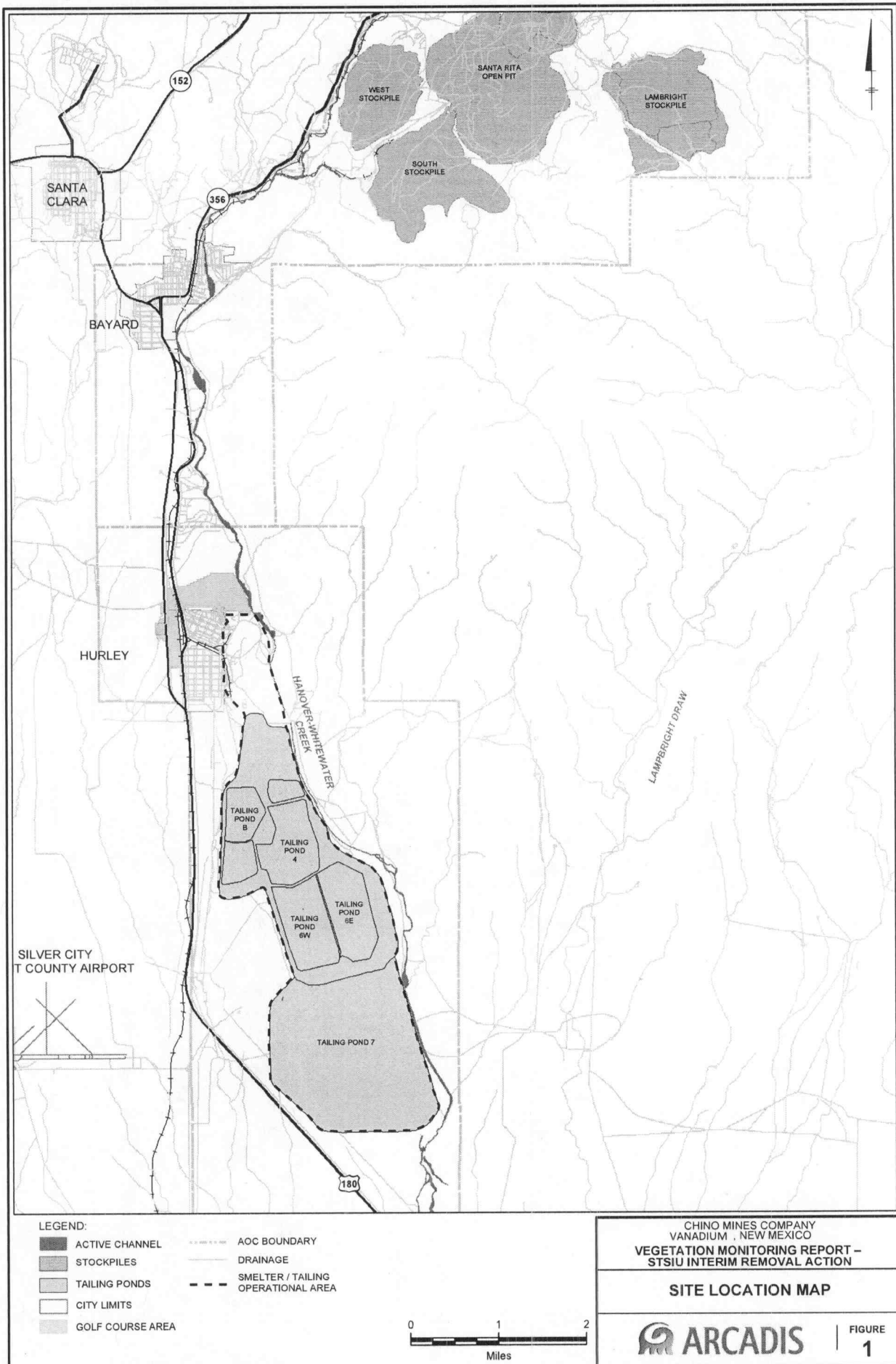
Table 6
Annual Precipitation, in Inches, for Pond 7 Precipitation Gauge

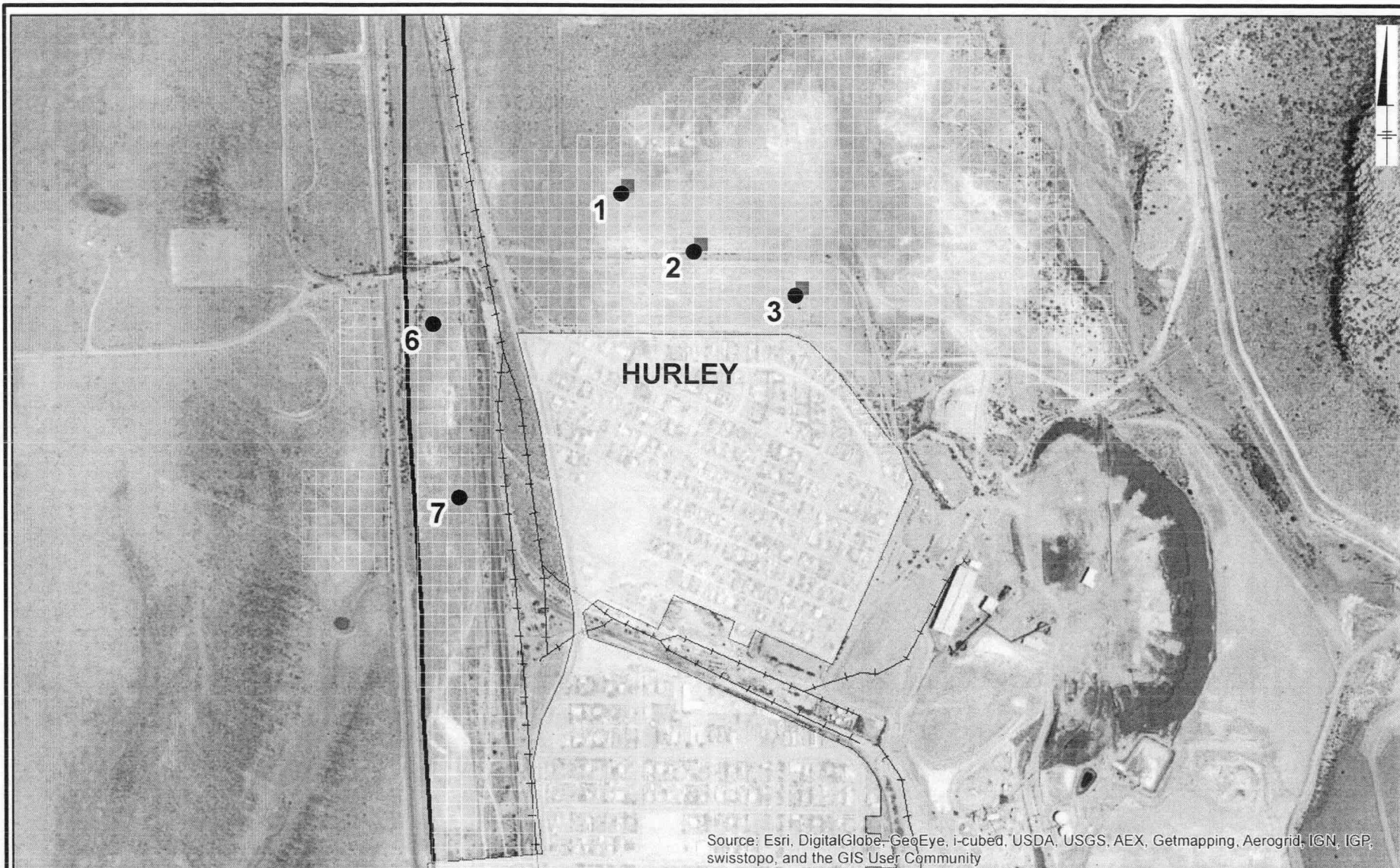
Freeport-McMoRan Chino Mines Company
Vanadium, New Mexico
Smelter Tailings Soils IU

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual Total
2008	0.43	0.31	0.00	0.00	1.63	1.01	7.21	1.60	2.45	0.30	0.51	0.35	15.80
2009	0.07	0.01	0.33	0.01	0.63	0.45	2.66	2.23	0.84	0.73	0.13	0.82	8.91
2010	2.09	0.95	0.49	0.24	0.12	0.29	6.37	1.82	1.01	0.42	0.00	0.20	14.00
2011	0.01	0.05	0.00	0.00	0.00	0.09	1.64	3.58	0.66	0.51	0.92	3.08	10.54
2012	0.18	0.70	0.16	0.00	0.08	0.02	0.92	2.04	0.68	0.08	0.00	0.23	5.09
2013	0.56	0.00	0.00	0.04	0.00	0.00	3.80	1.92	1.75	0.00	0.78	0.74	9.59

Notes:

* Partial data for month





Legend

- Coordinate Location
- Sampling Grid (100' x 100' Cells)

0 950 1,900
 SCALE IN FEET

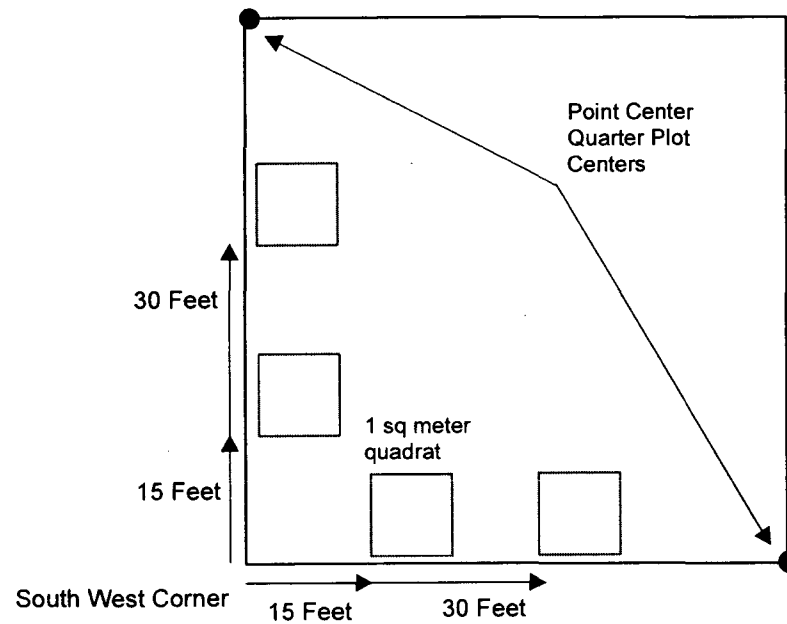
CHINO MINES COMPANY
 VANADIUM, NEW MEXICO
 VEGETATION MONITORING REPORT –
 STSIU INTERIM REMOVAL ACTION

GOLF COURSE GRID
 SAMPLING AREA

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FIGURE
 2

TYPICAL TRANSECT LAYOUT



NOT TO SCALE

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STSIU INTERIM REMOVAL ACTION

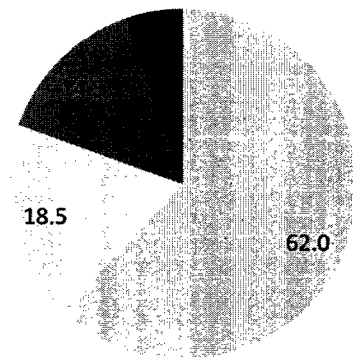
TRANSECT / QUADRAT LAYOUT



FIGURE

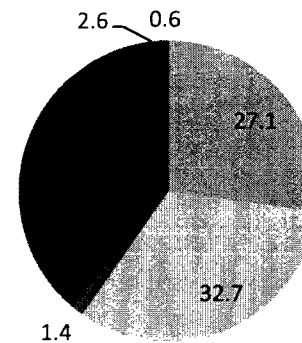
3

Mean Canopy Cover Components



Total Vegetative Cover
 Total Rock Cover
 Total Bare Soil Cover
 Total Litter Cover

Proportional Canopy Cover Contributed by Plant Classes



Annual Forb
 Perennial Forb
 Annual Grass
 Perennial Grass
 Shrub
 Tree (seedling)

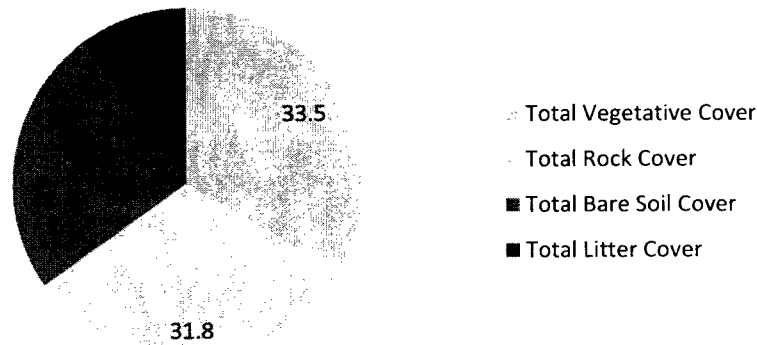
CHINO MINES COMPANY
 VANADIUM, NEW MEXICO
**VEGETATION MONITORING REPORT -
 STSIU INTERIM REMOVAL ACTION**

MEAN CANOPY COVER GRAPHS

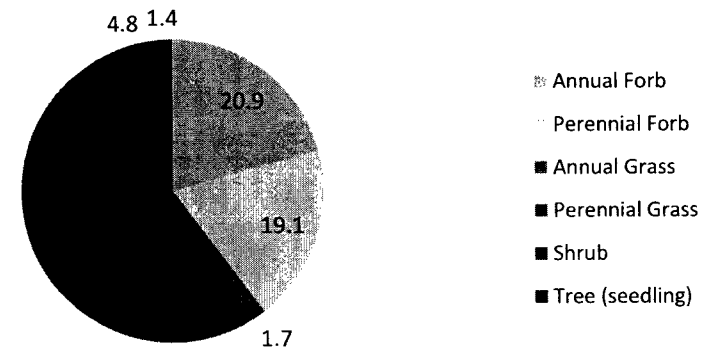


FIGURE
4

Mean Basal Cover Components



Proportional Basal Cover Contributed by Plant Classes



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VANADIUM, NEW MEXICO
**VEGETATION MONITORING REPORT -
STSIU INTERIM REMOVAL ACTION**

MEAN BASAL COVER GRAPHS



FIGURE
5

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Appendix A

Quarterly Inspection Reports and
2009/2010 Vegetation Surveys

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Quarterly Inspection Reports

CHINO EROSION/RECLAMATION INSPECTION FORM

X Quarterly

Monthly

Reclamation Unit:

Hurley Golf Course IRA-STSW

Weather Conditions:

Wet & cloudy, cold

Inspector:

Pam Pinson

Time/Date:

12-30-09 9:30 am

Vegetation Conditions:

Same as Sept '09 monitoring except
brown from winter season.

Ditches/Water Control:

Good Shape w/ ripping as
indicated on map.

Monitoring Stations:

Transect #1 - same as Sept. 09

Transect #2 - same as Sept. 09

Will install more w/ spring growth to
track expected changes!

Other Observations:

Reclamation performed ripping
as asked!

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit:

Golf Course IRA Site

Weather Conditions:

Sunny

Inspector:

Pam Dixon (Phil Harrigan print)

Time/Date:

3-31-2010

1:30

Vegetation Conditions:

Winter Conditions as in a December inspection. Wet winter though has started annuals to grow.

Ditches/Water Control:

Same

Monitoring Stations:

NA

Other Observations:

None

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit: Golf Course IRA Site	Weather Conditions: Sunny. Breezy.
Inspector: Kevin Fox	
Time/Date: June 23, 2007 1:30 pm	
Vegetation Conditions: Kevin reported annuals doing really well due to winter moisture. No other changes.	
Ditches/Water Control: No erosion issues.	
Monitoring Stations: NA	
Other Observations: None	

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit: Golf Course IRTA Site	Weather Conditions: Sunny, Breezy
Inspector: Tom Pearson	
Time/Date: 9-30-2010 2:00 PM	
Vegetation Conditions: Good vegetation coverage from high precipitation monsoon season. Side oats gramma really took hold.	
Ditches/Water Control: Good	
Monitoring Stations: See below	
Other Observations: Setup photo points and took pictures. Noted vegetation coverage at photo points.	

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit:

Golf Course T.R.A Site

Inspector:

Cody Clifton C.R. Clifton

Time/Date:

10:03 am 12-29-10

Weather Conditions:

Cold, windy, stormy

Vegetation Conditions:

Vegetation is in these areas, but in winter condition.

Ditches/Water Control:

Ditches + water control to be up holding annual rains + snow showers.

Monitoring Stations:

N/A

Other Observations:

Fence down in one area. (see map)

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit: Golf Course IRA Site	Weather Conditions: Windy! Sunny
Inspector: Dawn Pingleton	
Time/Date: Mar. 21, 2011 3:00pm	
Vegetation Conditions: Still winter conditions.	
Ditches/Water Control: NO change	
Monitoring Stations: NA	
Other Observations: None	

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit: Golf Course IRA site	Weather Conditions: Overcast to sunny
Inspector: Pam Pearson	
Time/Date: June 30, 2011 3:20 pm	
Vegetation Conditions: No changes since March '11 inspection. Dry winter conditions carried over to early summer. Yucca / elms / minor mesquite only "green" in pastures.	
Ditches/Water Control: No change	
Monitoring Stations: N/A	
Other Observations: None	

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit:

Golf Course IRTA Site

Weather Conditions:

Sunny

Inspector:

Dan Pinson

Time/Date:

9-27-2011 10:15 am

Vegetation Conditions:

Due to low precipitation from monsoon season, not as green and lush as last year. Repeat photo points in Sept. 2012.

Ditches/Water Control:

No Change

Monitoring Stations:

NA

Other Observations:

None.

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit: Golf Course I.R.A. Site	Weather Conditions: Cold & overcast Breezy.
Inspector: Cody Clifton	
Time/Date: 12-31-11 11:00 am	
Vegetation Conditions: Winter conditions, vegetation dormant. Snow still melting off of site. Muddy roads.	
Ditches/Water Control: Minor erosion in north site (north of bridge). See field map)	
Monitoring Stations: NA	
Other Observations: Some snow cover.	

CHINO EROSION/RECLAMATION INSPECTION FORM

Quarterly

Monthly

Reclamation Unit: Hurley Golf Course	Weather Conditions: Clear Warm
Inspector: Steve Garcia	
Time/Date 6/21/2012 9:30	
Vegetation Conditions: Dry conditions, some new growth visible	
Ditches/Water Control: No Visible Concerns	
Monitoring Stations: N/A	
Other Observations:	

Chino Mines Co. Reclamation/Erosion Monitoring Form

☐ Monthly
☒ Quarterly
☐ 1" Rain Event

Reclamation Unit: <i>Golf Course - Hurley</i>		Weather Conditions: <i>Clear sunny</i>
Inspector: <i>Steven Garcia</i>		
Time/Date: <i>10:00 AM 9-26-2012</i>		
Vegetation Conditions: <i>Drought conditions. Sparse growth visible.</i>		Fences/Livestock: <i>No visible concerns.</i>
Ditches/Water Control: <i>No visible concerns.</i>		Significant Erosion (Attach Description): <i>None noted.</i>
Monitoring Stations: <i>NA</i>		
Other Observations:		

Chino Mines Co. Reclamation/Erosion Monitoring Form

☐ Monthly
☒ Quarterly
☐ 1" Rain Event

Reclamation Unit: <i>GOLF COURSE.</i>		Weather Conditions: <i>Clear/Cool</i>
Inspector: <i>Steve Garcia</i>		
Time/Date: <i>12-12-2012</i>		
Vegetation Conditions: <i>Dry vegetation visible.</i>		Fences/Livestock: <i>No Visible Concerns</i>
Ditches/Water Control: <i>No Visible Concerns</i>		Significant Erosion (Attach Description): <i>None Noted.</i>
Monitoring Stations: <i>None.</i>		
Other Observations: <i>Clear Further Cleanup in Progress in And Around GOLF COURSE.</i>		

Chino Mines Co. Reclamation/Erosion Monitoring Form

☐ Monthly
☒ Quarterly
☐ 1" Rain Event

Reclamation Unit: <i>Golf Course</i>	Weather Conditions: <i>Clear & warm</i>
Inspector: <i>Steve Garcia</i>	
Time/Date: <i>1100 am 3-28-2013</i>	
Vegetation Conditions: <i>Dry, dead vegetation visible.</i>	Fences/Livestock: <i>Good. no visible concerns</i>
Ditches/Water Control: <i>No visible concerns.</i>	Significant Erosion (Attach Description): <i>None visible</i>
Monitoring Stations: <i>None</i>	
Other Observations:	

Chino Mines Co. Reclamation/Erosion Monitoring Form

☐ Monthly
☒ Quarterly
☐ 1" Rain Event

Reclamation Unit: <i>Golf Course</i>	Weather Conditions: <i>clear & Hot</i>
Inspector: <i>S. Garcia</i>	
Time/Date: <i>1:30 PM 6-19-2013</i>	
Vegetation Conditions: <i>Dry vegetation</i>	Fences/Livestock: <i>none</i>
Ditches/Water Control: <i>No Visible Concerns.</i>	Significant Erosion (Attach Description): <i>non visible</i>
Monitoring Stations: <i>N/A</i>	
Other Observations:	

Chino Mines Co. Reclamation/Erosion Monitoring Form

☐ Monthly
☒ Quarterly
☐ 1" Rain Event

Reclamation Unit: <i>Hurley Golf Course</i>	Weather Conditions: <i>clear</i>
Inspector: <i>Steve Garcia</i>	
Time/Date: <i>9-25-2013</i>	
Vegetation Conditions: <i>Good lush grass and wild flowers visible throughout.</i>	Fences/Livestock: <i>None</i>
Ditches/Water Control: <i>No visible concerns.</i>	Significant Erosion (Attach Description): <i>None</i>
Monitoring Stations: <i>None</i>	
Other Observations: <i>Wash out on road just past orange gates</i>	

Chino Mines Co. Reclamation/Erosion Monitoring Form

☐ Monthly
☒ Quarterly
☐ 1" Rain Event

Reclamation Unit: <i>GOLF COARSE</i>	Weather Conditions: <i>cloudy/drizzling rain</i>
Inspector: <i>Steven Garcia</i>	
Time/Date: <i>10:30 AM 12-12-13</i>	
Vegetation Conditions: <i>Abundant dry grass/shrubs visible.</i>	Fences/Livestock: <i>No visible concerns.</i>
Ditches/Water Control: <i>No visible concerns.</i>	Significant Erosion (Attach Description): <i>None visible</i>
Monitoring Stations: <i>NA</i>	
Other Observations:	

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2009 Vegetation Survey

HURLEY GOLF COURSE IRA 2009 ANNUAL VEGETATION MONITORING
LOCATION MAP FOR MODIFIED STYS POINT COUNT
SEPTEMBER 23, 2009
SEE ATTACHED SURVEY DATA SHEETS

Same as T#2

Transect #1
40% Bare

Same as T#1
55% Bare

Same as T#2

Same as T#1
40% Bare

Transect #2
70% Bare











Same as T#2



Survey: Modified Stys Point Count
by Jerry Donaldson & Pam Pinson

DATE: September 23, 2009 - 9:30 am

LOCATION: Transect #1 - North Section of Golf Course. Photo pt West to High Point on Line Mtn w/ Telephone Pole

Total Count	Bare Ground (BG)	Litter (plant material)	Annual Vegetation	Perennial Vegetation	Species — no count
	 	 1	 	 	side oats gramma composite — sunflower — 1 composite — 2 composite — 3
	 				Brown Snake weed 3 Ann — grass & purple (2) Composite 4 rattle weed pigweed
	40% Bare	12% litter	28% Annual Vegetation	20% Perennial V.	estragulus — milkweed vine — mesquite — grass Antelope brush elm tree plants bristle grass
					paper daisy hog potatoe silver leaf nightshade Composite 5
					Ragweed globe mallow Puff grass Composite 6
					Blue gramma Blue stem?
					tumblegrass? Composite 7 Yucca, sand drop seed Dig weed (repeat)

Notes:

Notes: Jerry says too much elm - kill w/ roundup. Pull seed bag next time.

Note: Rabbit pellets present in transect; Antpiles

Good to see Barry

Good Soil w/ clay & caliche - Keeps dust controlled





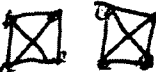

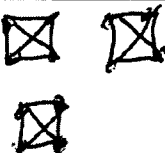
Russian thistle
Mosquito
comp 8 - stickweed

Modified Stys Pond Count
Survey by Jerry Donaldson/Pam Pinson

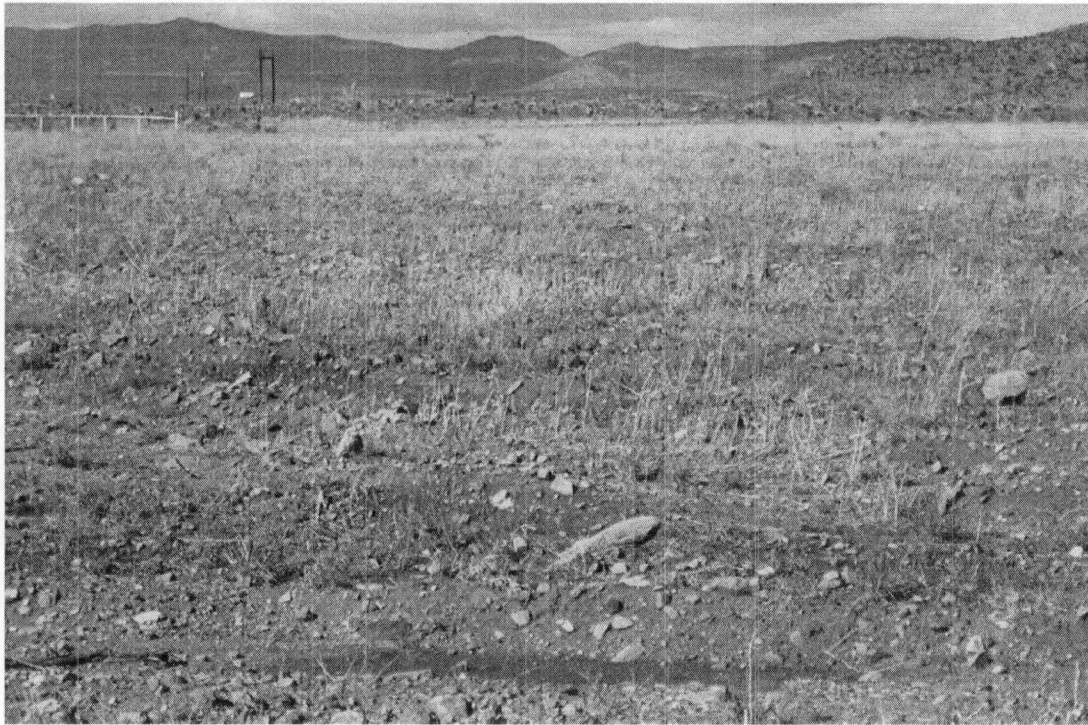
DATE: Sept. 23, 2009 11:00 am

LOCATION: Transect #2 - McCaskey Acres west of Hwy 180

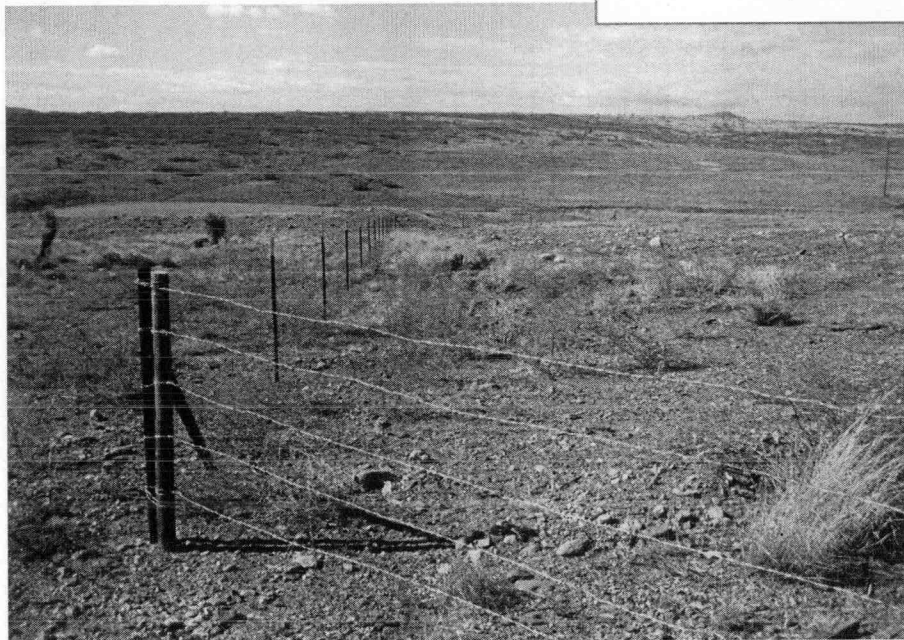
total
count

Bare Ground (BG)	Litter (plant material)	Annual Vegetation	Perennial Vegetation	Species
				Same as transect #2
				
				
70% Bare	2% Litter	13% Annuals	15% Perennial	

OCTOBER 21, 2009 TRANSECT 1, NORTH
AND SOUTH GOLF COURSE REMEDIATED
PARCELS



OCTOBER 21, 2009 TRANSECT 2 AREA
McCAULEY PASTURE, WEST OF HWY 180



OCTOBER 21, 2009
EAST OF HWY 180
REMEDIED
PARCELS



SOUTH PARCEL LOOKING SOUTH



NORTH PARCEL LOOKING NORTH

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2010 Vegetation Survey

HURLEY GOLF COURSE IRA 2010 ANNUAL VEGETATION MONITORING
LOCATION MAP FOR PHOTO SURVEY
SEPTEMBER 30, 2010
SEE ATTACHED PHOTO DOCUMENTATION

Photo Survey Performed by Pam
Pinson, Chino Mines Company

Photo Point 4

Photo Point 1
35% Bare
(2009 Transect 1)

Photo Point 2
35% to 40% Bare

Photo Point 3
40% Bare

Photo Point 5
50% Bare
(2009 Transect#2)



DATE: September 30, 2016 1:30 pm

LOCATION: 2009
Transect #1 & Photo Pt 1

See Map
See Photos. Survey by Pam Pinson

Bare Ground (BG)	Litter (plant material)	Perennial and Annual Vegetation	Perennial Vegetation	Species
☒ ☒	∴	☒ ☒ ☒		Side Oak Russian Thistle Shaleweed
☒		☒ ☒ ☒		Blue John Mesquite Vine Raywood
		L		Globe Mallow Winterfat low green perennial? Others - see photos
30% Bare	4% Litter	66% Vegetation		

PHOTO POINT # 1
SEPTEMBER 30, 2010

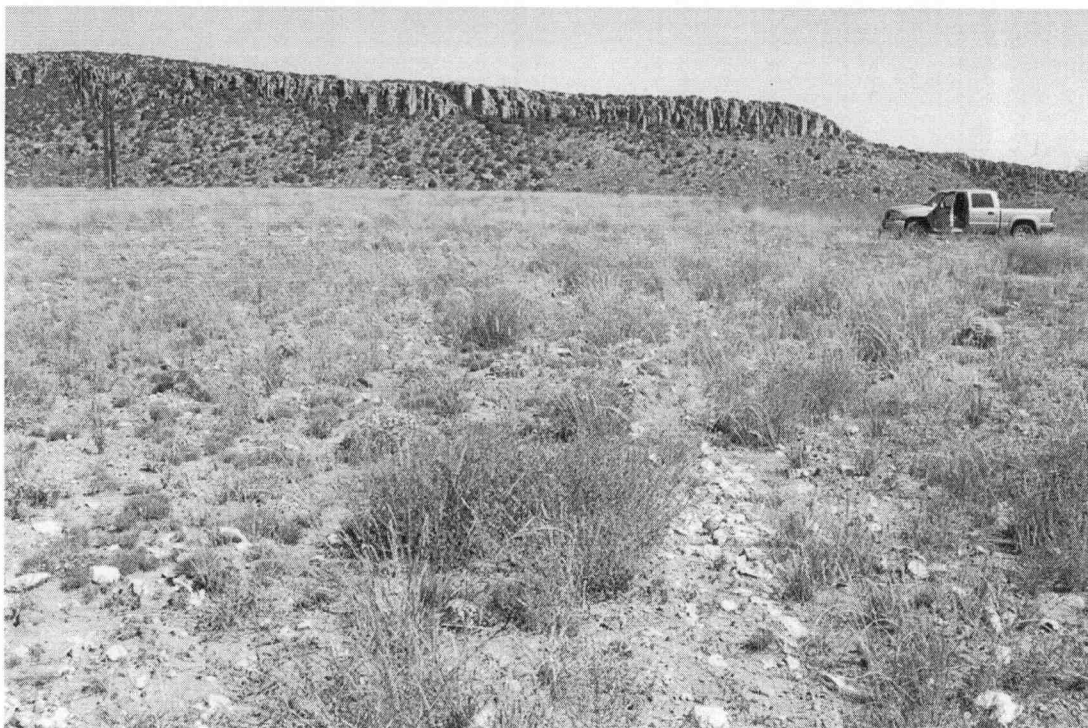
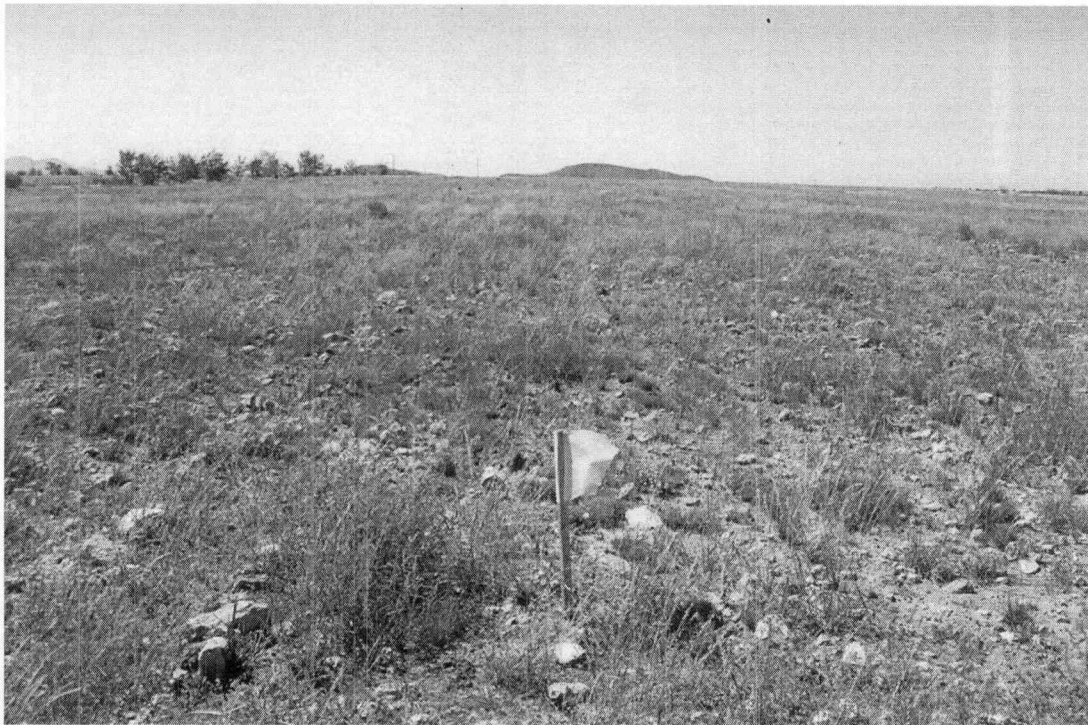


PHOTO POINT 1
SEPTEMBER 30, 2010
DOMINANT PLANTS



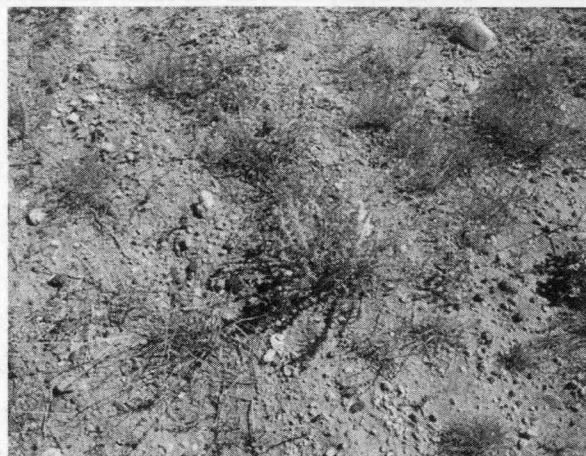


PHOTO POINT 1
SEPTEMBER 30, 2010
INDIVIDUAL PLANTS



PHOTO POINT 2
SEPTEMBER 30, 2010

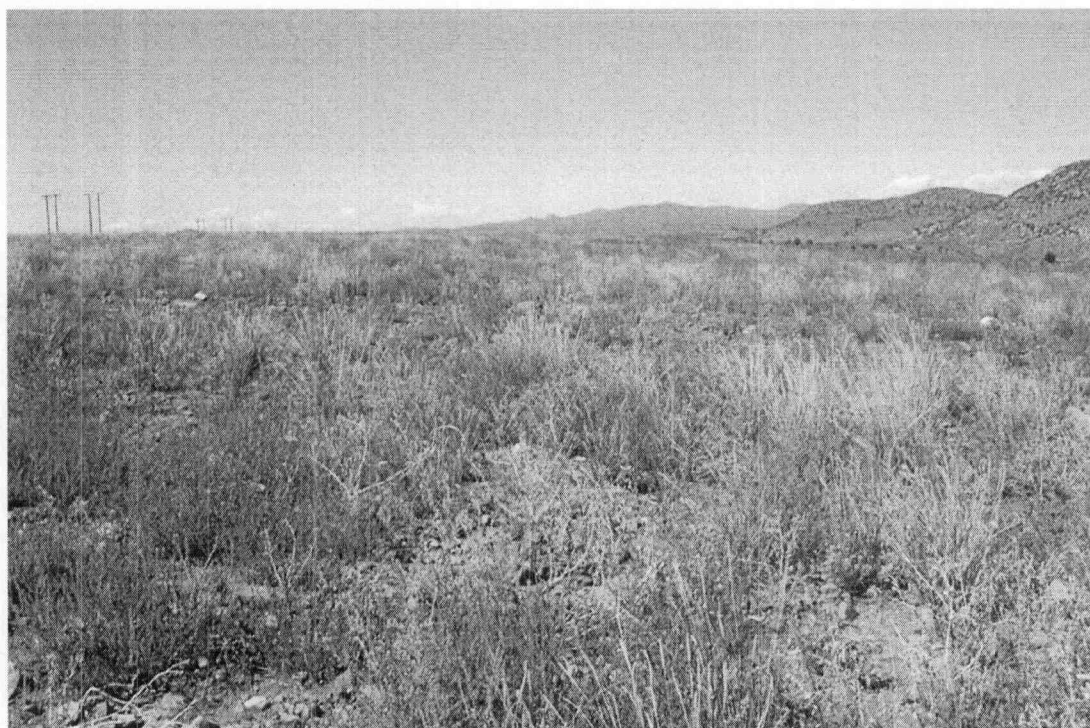
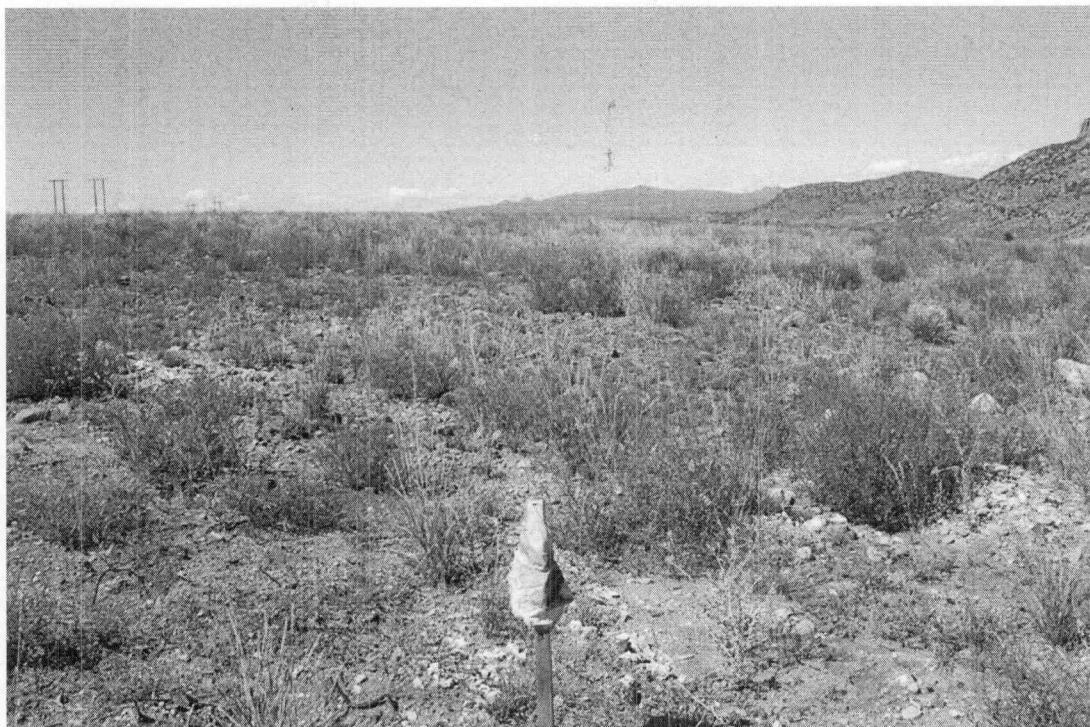


PHOTO POINT 2
SEPTEMBER 30, 2010

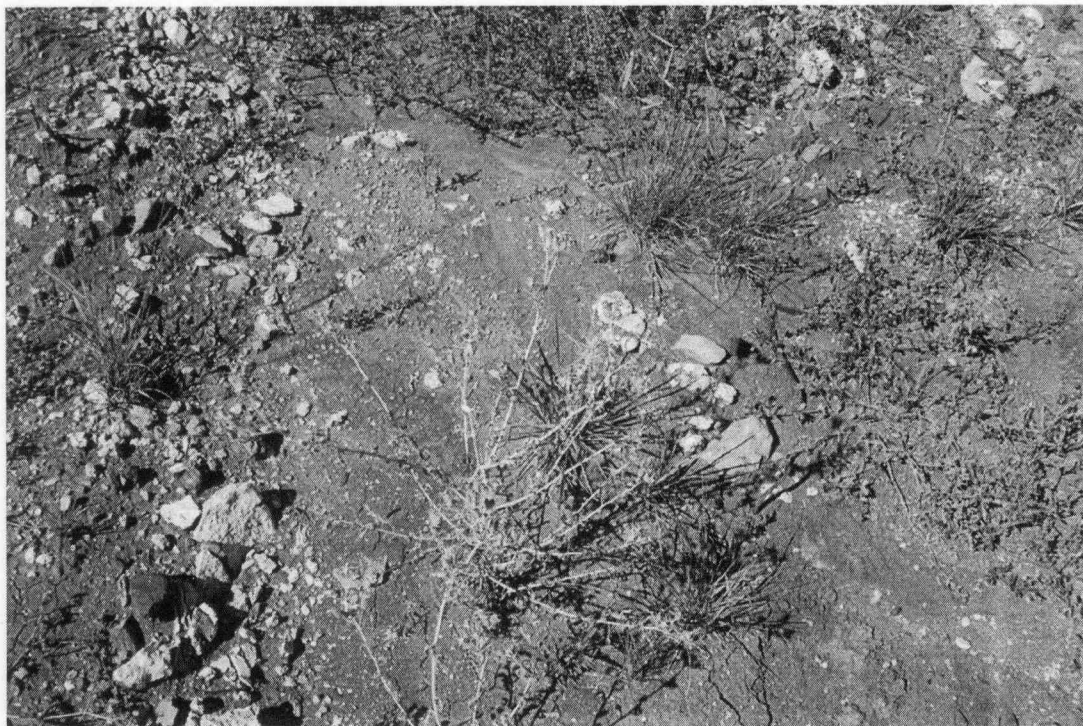


Photo Point 3
September 30, 2010

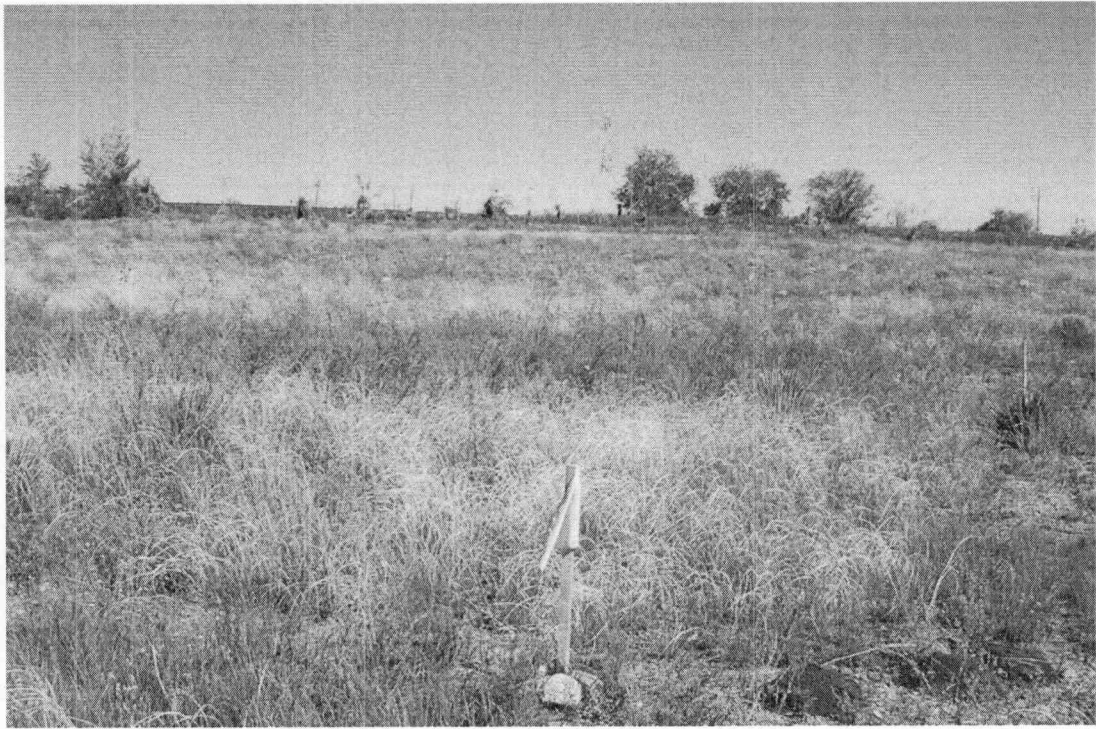


PHOTO POINT 3
SEPTEMBER 30, 2010



Photo Point 4
September 30, 2010



Photo Point 4
September 30, 2010



PHOTO POINT 5
SEPTEMBER 30, 2010

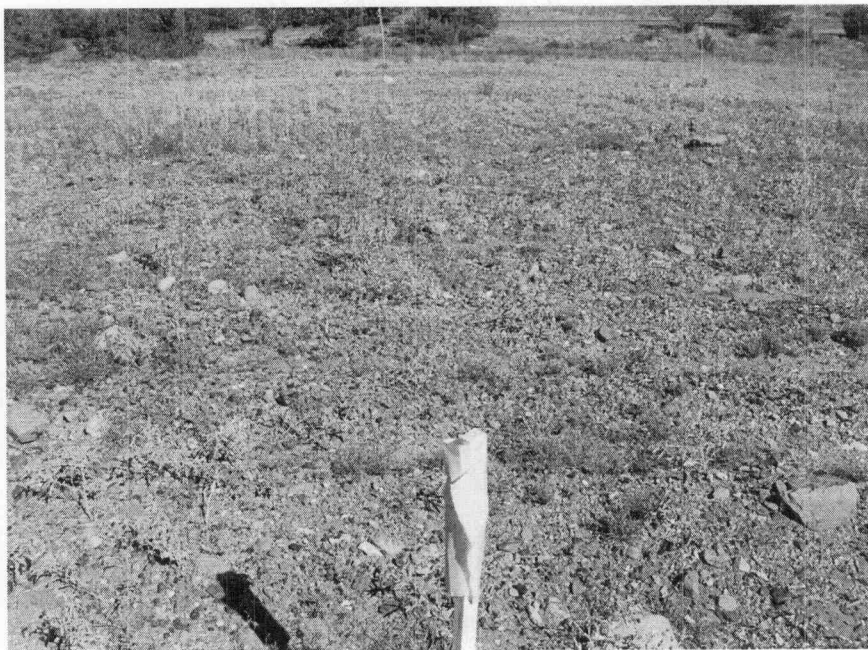


Photo Point 5 McCauley pasture

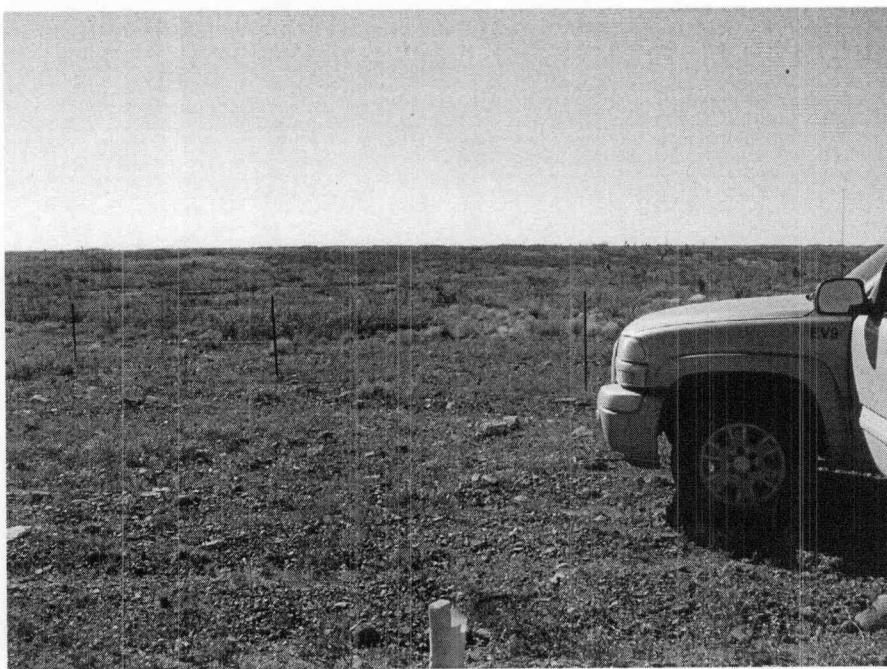


Photo Point 5 looking west



Photo Point 5 looking east



Photo Point 5 dominant plant



Photo Point 5 minor plants



Photo Point 5 minor vegetation

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Appendix B

Vegetation Data 2013

APPENDIX B
VEGETATION DATA
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
SMELTER TAILINGS SOILS IJ

Species Name		Stratum	Block 1 Quad 1			Block 1 Quad 2			Block 1 Quad 3			Block 1 Quad 4			Block 2 Quad 5			Block 2 Quad 6			Block 2 Quad 7		
			Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #
Common	Latin																						
Carelessweed	<i>Amaranthus palmeri</i>	Annual Forb	10	20		5	15		15	40		5	20		10	20		2	5		10	25	
Acacia seedling	<i>Acacia</i> sp.	Annual Forb	0.1	0.1		0.1	3											0.1	3				
Dogweed	<i>Dysodia peysson</i>	Annual Forb																					
Tansy aster	<i>Machaeranthera tanacetifolia</i>	Annual Forb				0.1	0.1		0.1	3													
Six-weeks grass	<i>Bouteloua barbata</i>	Annual grass																					
Bearded daisy	<i>Dalea pycnostachya</i>	Perennial Forb	0.1	3		5	30		5	40		5	20		0.1	5		5	5		5	20	
Slender birdweed	<i>Convolvulus equitans</i>	Perennial Forb																					
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	Perennial Forb				1	3																
Scaly globe mallow	<i>Sphaeralcea leptophylla</i>	Perennial Forb	3	10																			
Spreading fan petals	<i>Sida elaeagnifolia</i>	Perennial Forb	0.1	3											0.1	0.1							
Blackfoot	<i>Malampodium leucanthum</i>	Perennial Forb	0.1	0.1		3	5		0.1	3		0.1	5					0.1	3				
Scarlet globe mallow	<i>Sphaeralcea coccinea</i>	Perennial Forb																					
Baby aster	<i>Cheilotropis ericoides</i>	Perennial Forb										0.1	0.1		0.1	0.1		0.1	3				
Twin leaf senna	<i>Senna bauhinioides</i>	Perennial Forb																					
Side-oats grass	<i>Bouteloua curtipendula</i>	Perennial Grass	35	35		5	5		5	10		10	15		3	3		5	5				
Red three awn	<i>Aristida purpurea</i>	Perennial Grass																					
Tobacco	<i>Pleurophus multiflorus</i>	Perennial Grass																					
Blue grass	<i>Bouteloua gracilis</i>	Perennial Grass										5	5		0.1	0.1							
Beardgrass	<i>Bouteloua barbata</i>	Perennial Grass													3	3							
Soap tree yucca	<i>Yucca elata</i>	Shrub										5	5	1							5	5	
Winterfat	<i>Koeberlinia laevigata</i>	Shrub																					
Honey mesquite	<i>Prosopis glandulosa</i>	Shrub																					
Chinese elm	<i>Ulmus parvifolia</i>	Tree (seedling)																					
Unknown grass						0.1	0.1								3	3		0.1	3				
Unknown seedling																							
Total Vegetative Cover			50	70		20	60		25	80		30	70		20	40		15	30		20	50	
Total Rock Cover			20	15		60	30		50	10		40	15		50	30		60	45		35	25	
Total Bare Soil Cover			25	10		10	5		15	5		20	10		20	25		20	20		35	20	
Total Litter Cover			5	5		10	5		10	5		10	5		10	5		5	5		10	5	

Note: Number of individuals only completed for tree or shrub species.

APPENDIX B
VEGETATION DATA
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
SMELTER TAILINGS SOILS II

Species Name			Block 2			Block 3			Block 3			Block 3			Block 3			Block 6			Block 6		
			Quad 8			Quad 9			Quad 10			Quad 11			Quad 12			Quad 13			Quad 14		
Common	Latin	Stratum	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #
Carelessweed	<i>Amaranthus palmeri</i>	Annual Forb	5	20		0.1	3		5	15		5	10		0.1	5		5	15		0.1	5	
Acacia seedling	<i>Acacia</i> sp.	Annual Forb																					
Dogweed	<i>Dryasdia papposa</i>	Annual Forb																					
Tansey aster	<i>Machaeranthera tanacetifolia</i>	Annual Forb																					
Six-weeks grama	<i>Boutelous barbata</i>	Annual grass							10	10													
Bearded daisy	<i>Dalea pycnostachya</i>	Perennial Forb	3	5		3	5		5	10		5	20		0.1	5		5	30		3	10	
Dagger bindweed	<i>Convolvulus equitans</i>	Perennial Forb																0.1	15		0.1	5	
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	Perennial Forb																0.1	3		3	10	
Scaly globemallow	<i>Sphaeralcea leptophylla</i>	Perennial Forb				0.1	3																
Spreading fan petals	<i>Sida eburnea</i>	Perennial Forb																0.1	3		0.1	3	
Blackfoot	<i>Malvastrum leucanthum</i>	Perennial Forb				3	5		0.1	0.1		1	5		0.1	3							
Scarlet globe mallow	<i>Sphaeralcea coccinea</i>	Perennial Forb																0.1	2				
Baby aster	<i>Chaetopappa ericoides</i>	Perennial Forb																					
Twin leaf senna	<i>Senna baobaboides</i>	Perennial Forb																					
Side-oats grama	<i>Boutelous curtipendula</i>	Perennial Grass				20	20		5	5		20	30		10	10		25	35		40	70	
Red three awn	<i>Aristida purpurea</i>	Perennial Grass																					
Tobosa	<i>Pleuraphis mutica</i>	Perennial Grass																					
Blue grama	<i>Boutelous gracilis</i>	Perennial Grass				3	5		5	5		5	5		5	5					3	3	
Beardgrass	<i>Bothriochloa barbinodis</i>	Perennial Grass																					
Soap tree yucca	<i>Yucca elata</i>	Shrub																10	10	2			
Winterfat	<i>Kreschenbinkovia lanata</i>	Shrub																					
Honey mesquite	<i>Prosopis glandulosa</i>	Shrub																			0.1	3	
Chinese elm	<i>Ulmus parvifolia</i>	Tree (seedling)	3	3	2																		
Unknown grass												0.1	0.1		0.1	3		0.1	0.1				
Unknown seedling																							
Total Vegetative Cover			10	25		30	40		30	45		35	85		15	35		45	90		50	85	
Total Rock Cover			40	35		30	25		40	25		20	15		45	30		0	0		5	0	
Total Bare Soil Cover			40	35		35	30		20	25		35	15		30	30		30	5		40	10	
Total Litter Cover			10	5		5	5		10	5		10	5		10	5		25	5		5	5	

Note: Number of individuals only completed for tree or shrub species.

APPENDIX B
VEGETATION DATA
FREEPORT-MCMORAN CHINO MINES COMPANY
VANADIUM, NEW MEXICO
SMELTER TAILINGS SOILS UJ

Common	Species Name	Latin	Stratum	Block 6 Quad 15			Block 6 Quad 16			Block 7 Quad 17			Block 7 Quad 18			Block 7 Quad 19			Block 7 Quad 20			Frequency	Mean Basal Cover	Mean Cover
				Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #	Basal %	Canopy %	Indiv #			
Carelessweed	<i>Amaranthus palmeri</i>		Annual Forb							0.1	5		10	20		0.1	5		10	25		16	5.8	15.8
Acacia seedling	<i>Acacia</i> sp.		Annual Forb	5	20																	7	1.5	6.6
Ogweed	<i>Dysodia papposa</i>		Annual Forb										0.1	5		0.1	0.1		0.1	5		3	0.1	3.4
Tansy aster	<i>Machaeranthera tenacetifolia</i>		Annual Forb																			2	0.1	1.6
Six-weeks grass	<i>Bouteloua barbata</i>		Annual grass										0.1	5								2	6.1	7.5
Bearded daisy	<i>Deilephragma</i>		Perennial Forb	5	20		5	15		5	10		3	10		5	15		5	20		20	3.9	14.9
Dagger bindweed	<i>Convolvulus equitans</i>		Perennial Forb	0.1	5		0.1	5														4	0.1	7.5
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>		Perennial Forb	2	5		0.1	5														5	1.2	5.2
Scaly globemallow	<i>Sphaeralcea leptophylla</i>		Perennial Forb										0.1	5								2	1.6	7.5
Spreading fan petals	<i>Sida subulata</i>		Perennial Forb	0.1	0.1		0.1	0.1		5	10		3	5		5	15		3	5		11	1.5	4.3
Blackfoot	<i>Malvastrum leucanthum</i>		Perennial Forb							0.1	0.1		0.1	0.1		0.1	0.1					12	0.7	2.5
Scarlet globe mallow	<i>Sphaeralcea coccinea</i>		Perennial Forb																			1	0.1	2.0
Baby aster	<i>Cheilotrichia ericoides</i>		Perennial Forb													0.1	3					4	0.1	1.6
Twin leaf senna	<i>Senna bauchiioides</i>		Perennial Forb													0.1	0.1					1	0.1	0.1
Side-oats grama	<i>Bouteloua curtipendula</i>		Perennial Grass	30	35		50	70		40	50		3	5		25	30		10	15		18	18.9	24.9
Red three awn	<i>Aristida purpurea</i>		Perennial Grass										10	30					5	15		2	7.5	22.5
Toboss	<i>Pleuraphis mutica</i>		Perennial Grass																5	5		1	5.0	5.0
Blue grama	<i>Bouteloua gracilis</i>		Perennial Grass													3	3					8	3.6	3.9
Beardgrass	<i>Bothriochloa barbata</i>		Perennial Grass																			1	3.0	3.0
Soap tree yucca	<i>Yucca elata</i>		Shrub	5	5		15	20														4	8.8	10.0
Winterfat	<i>Krascheninnikovia lanata</i>		Shrub																			1	0.1	3.0
Honey mesquite	<i>Prosopis glandulosa</i>		Shrub																			1	3.0	3.0
Chinese elm	<i>Ulmus parvifolia</i>		Tree (seedling)																			1	0.1	3.0
Unknown grass																						5	0.7	1.3
Unknown seedling																								
Total Vegetative Cover				50	80		70	90		50	70		30	75		40	65		35	75			33.5	62.0
Total Rock Cover				0	0		0	0		30	20		40	15		35	20		35	15			31.6	16.5
Total Bare Soil Cover				35	10		15	5		10	5		20	5		20	10		20	5			24.8	14.3
Total Litter Cover				15	10		15	5		10	5		10	5		5	5		10	5			10.0	5.3

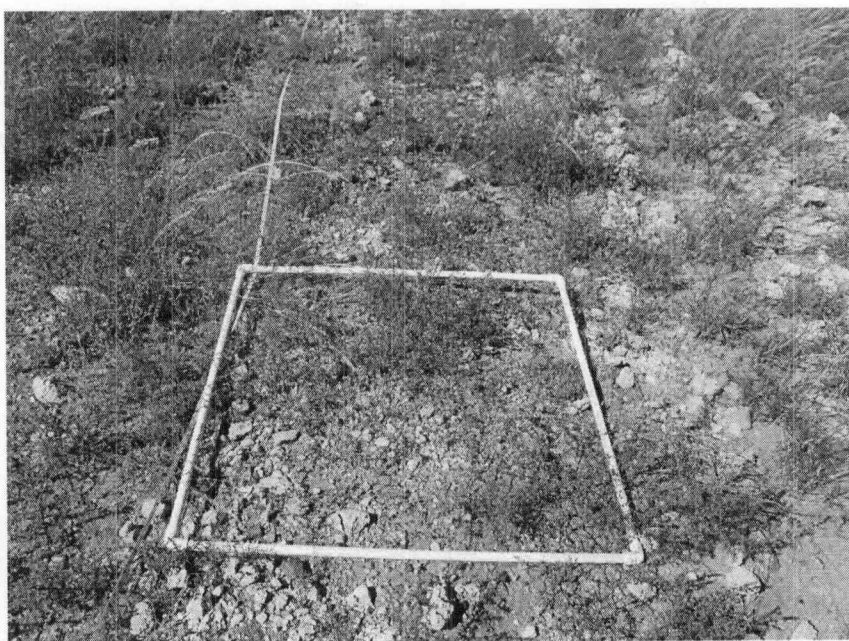
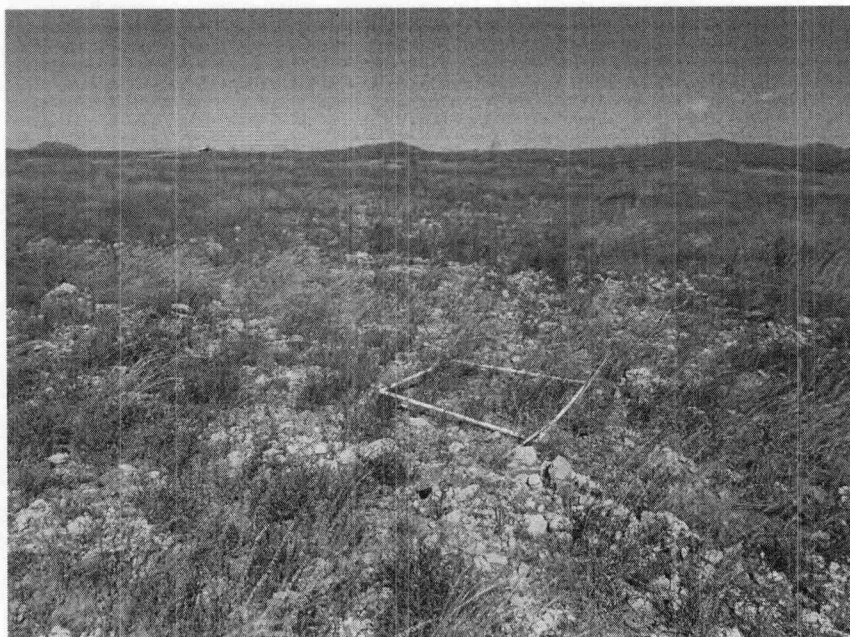
Note: Number of individuals only completed for tree or shrub species.

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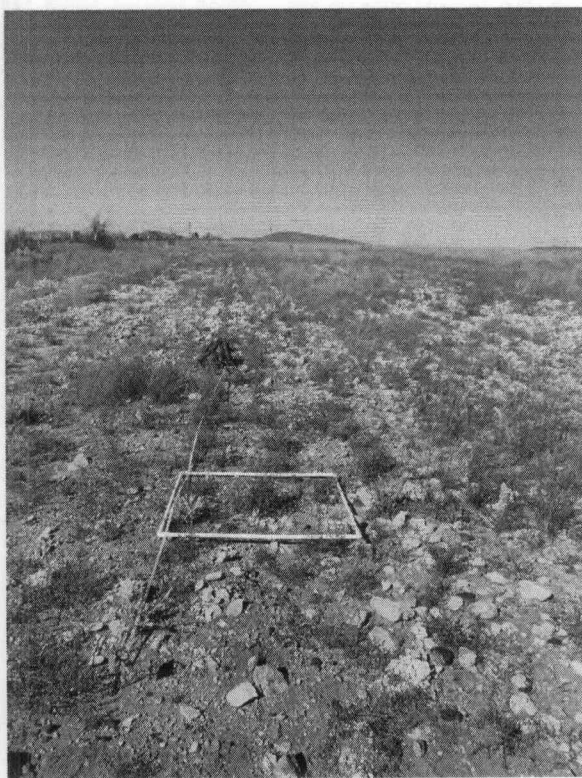
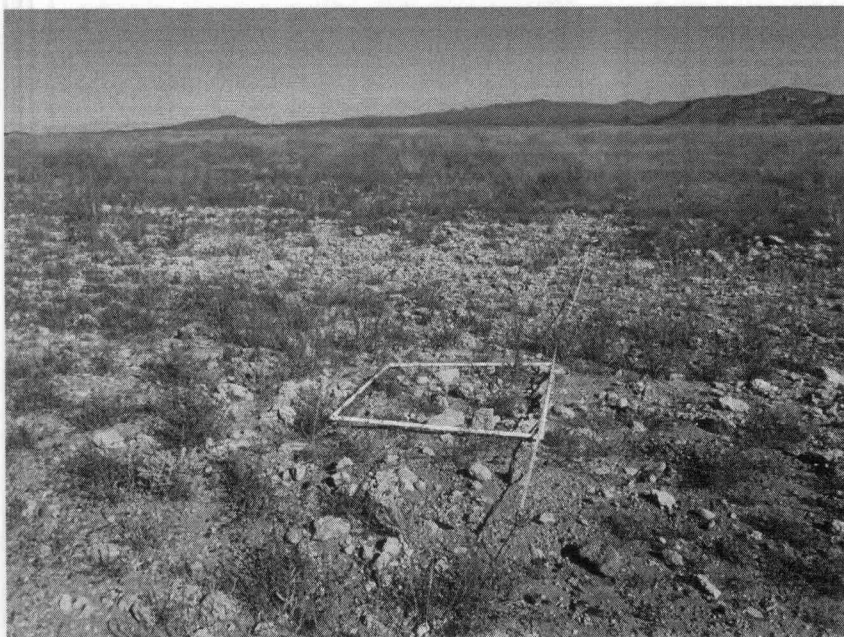
Appendix C

Photo Log October 2013.

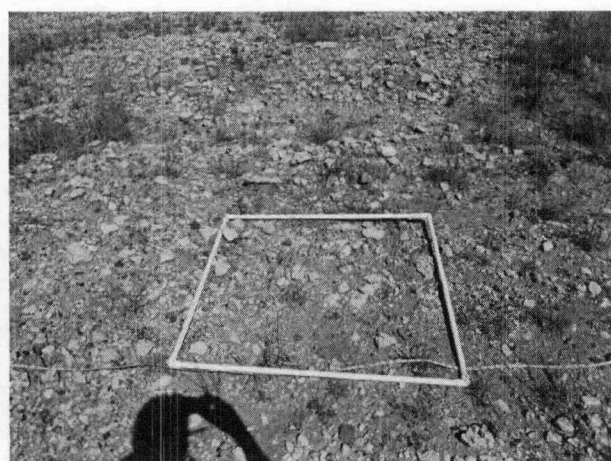
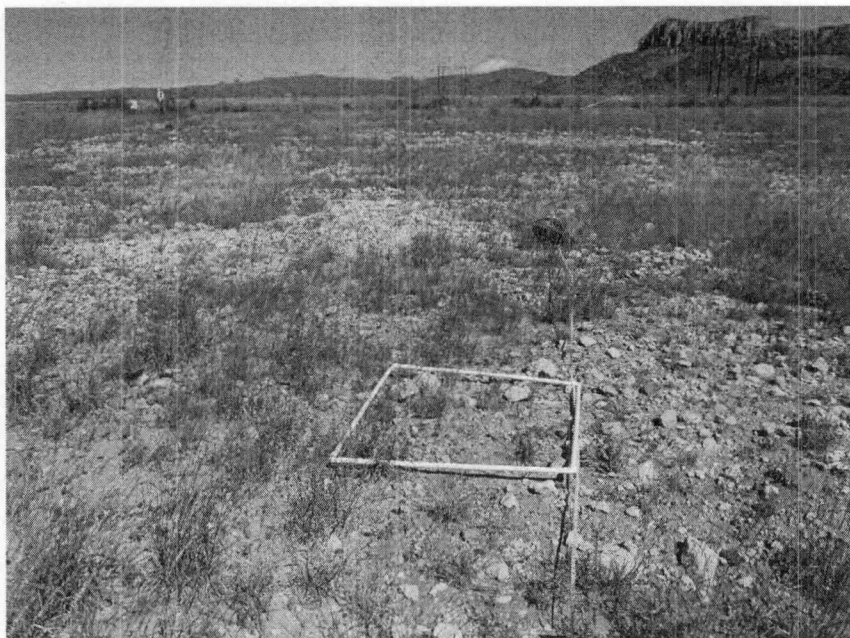
Photographs 1 & 2. Block 1, Transect 1 (top) & 2 (bottom).



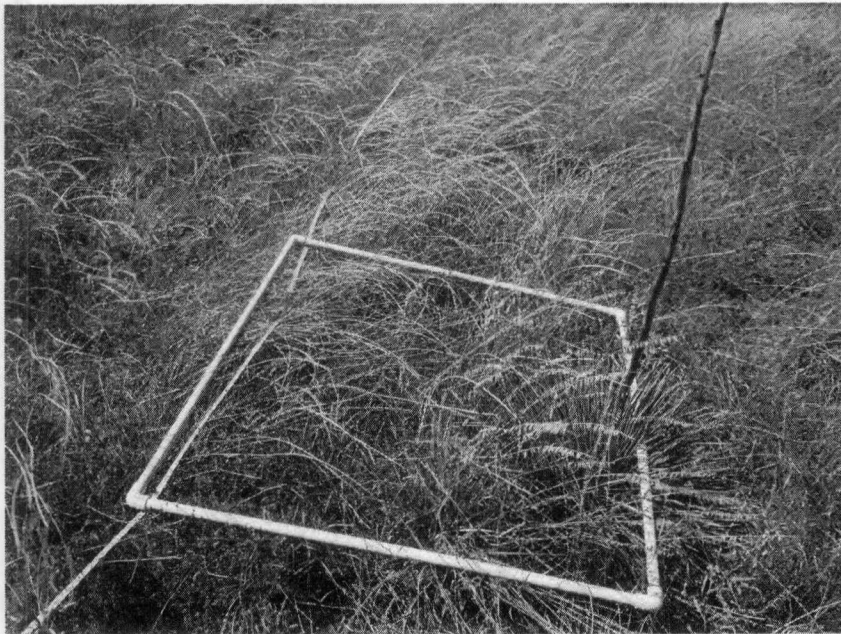
Photographs 3 & 4. Block 2, Transect 1 (top) & 2 (bottom).



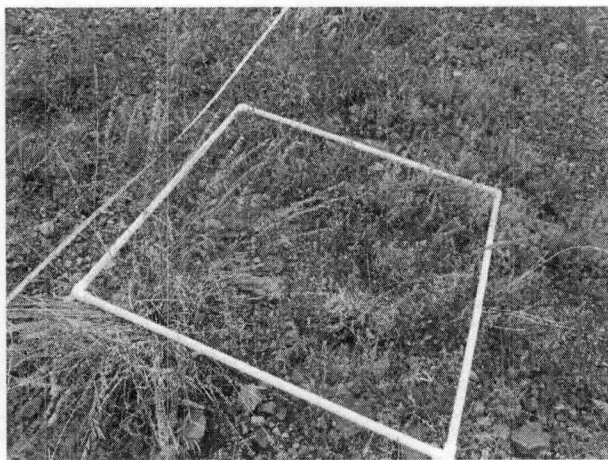
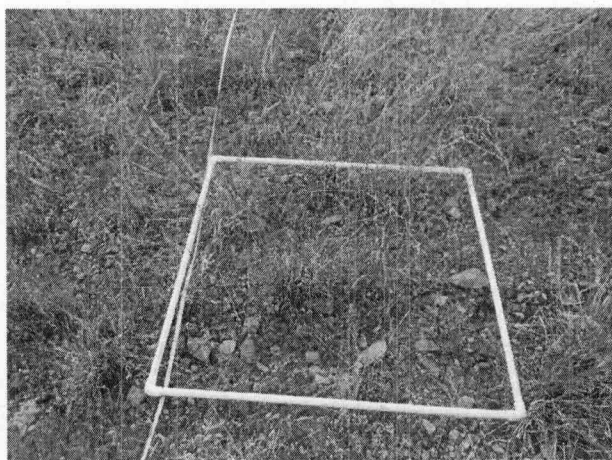
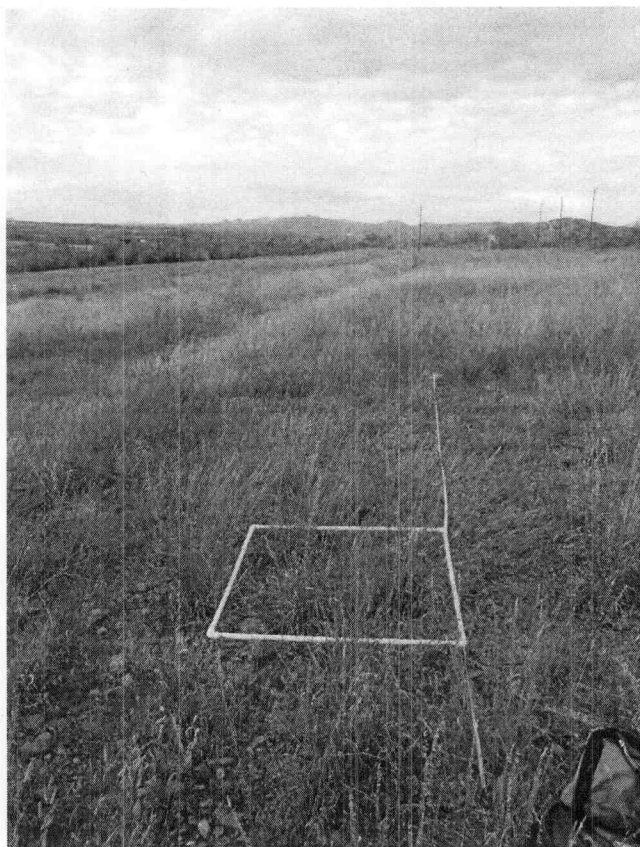
Photographs 5, 6 & 7. Block 3, Transect 1 (top) & Quadrats 3-3 & 3-4 (bottom)



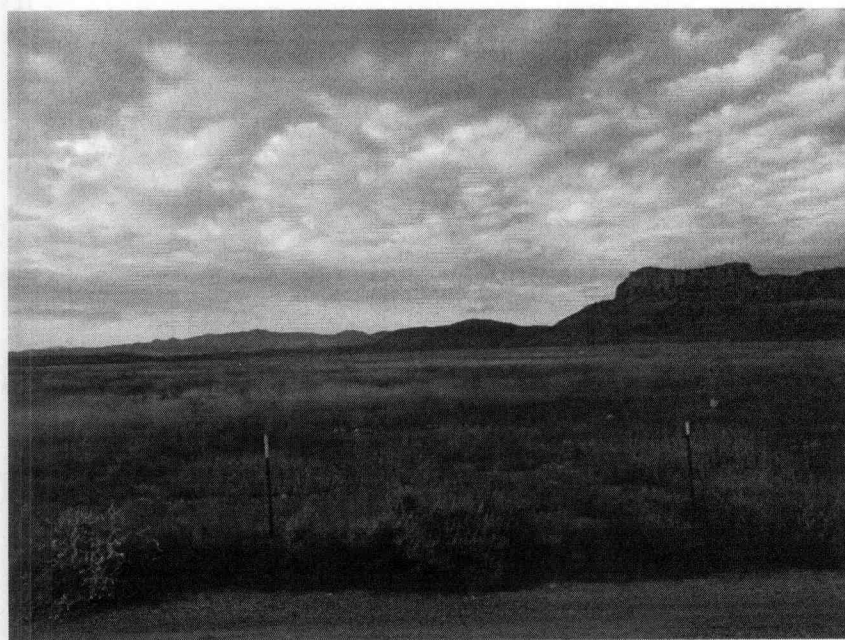
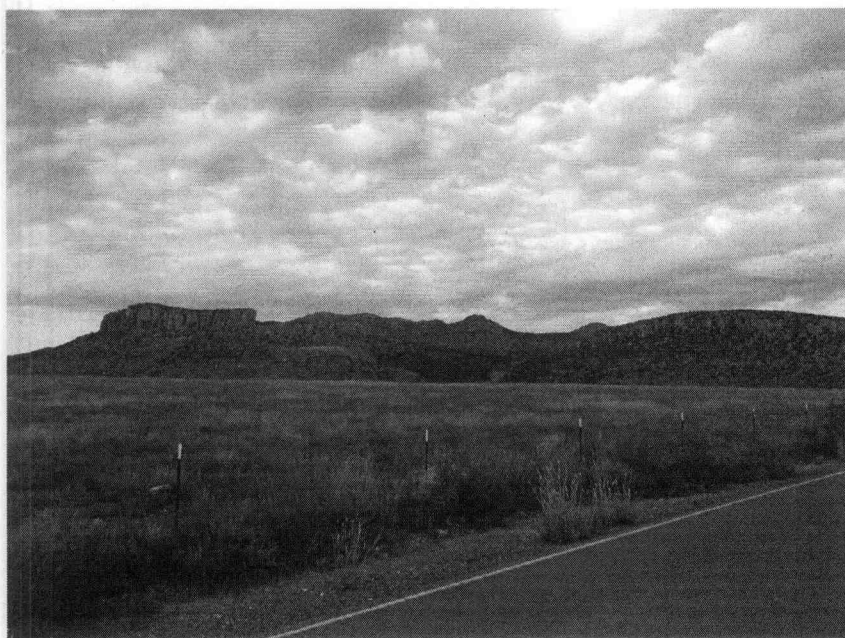
Photographs 8 & 9. Block 6, Transect 1 (top) & 2 (bottom)



Photographs 10 & 11. Block 7, Transect 1 (top) & Quadrats 4-3 & 4-4 (bottom)



Photos 12 & 13. Representative photographs northeast of railroad.



Photos 14 & 15. Representative photographs southeast of railroad.



Photo 16. Representative photograph northwest of railroad.



Photo 17. Representative photograph southwest of railroad.

